DOCUMENTS EXPEDITING PROJECT

[COMMITTEE PRINT]

PRELIMINARY REPORT
ON THE
ASPECTS OF THE MISSILE PROGRAM
IN THE
DEPARTMENTS OF THE NAVY AND THE AIR FORCE

SUBCOMMITTEE ON MANPOWER UTILIZATION
OF THE
COMMITTEE ON POST OFFICE AND CIVIL SERVICE
EIGHTY-SIXTH CONGRESS, FIRST SESSION

APRIL 1959

Printed for the use of the Subcommittee on Manpower Utilization

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UNITED STATES
GOVERNMENT PRINTING OFFICE
36377 WASHINGTON : 1959

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LETTER OF SUBMITTAL

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON MANPOWER UTILIZATION OF THE
COMMITTEE ON POST OFFICE AND CIVIL SERVICE,
April 21, 1959.

Hon. TOM MURRAY,
Chairman, Committee on Post Office and Civil Service,
House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: The Subcommittee on Manpower Utilization is conducting a study of the contracting out of Government responsibilities for administrative and management services, especially in the research and development of guided missiles and herewith submit a report of our findings to date.

Our subcommittee has a policy of keeping the departments and agencies informed of situations that can be improved. As a result, I am glad to note several improvements that have been made along this line since we began the investigation of manpower utilization in the missile programs in November 1957. For example:

(1) Our report points out that at the time of the survey, there was an overlap among some of the bureaus and a need for more unified top direction in the Department of the Navy missile program. Recently a Department of the Navy reorganization study was announced which is supposed to correct these things.

(2) Our December 1958 hearings pointed up areas of possible conflict of interest in specific cases, particularly in the Air Force ballastic missile program. Subsequently, the Secretary of the Air Force has issued policy statements setting forth guidelines for so-called think factories (i.e., research and development contractors) dealing with hardware-producing contractors.

(3) Within recent months certain reorganizations have been announced by the Office of Secretary of Defense which are reported to provide more unified overall control of the Defense Department's missile programs.

(4) Rotation policies for military officers have been revised by the Defense Department to be more flexible. This should reduce to some degree excessive military turnover in critical work areas, an item of considerable importance to our subcommittee.

(5) Early this year Army announced a new recruiting program geared to fit the labor market and the overall personnel requirements of Army. It is hoped this move will lead the way for a more effective Federal recruiting program.

(6) The Bureau of the Budget recently issued a policy statement regarding the procedures for the selection, supervision, and management of contractors. This statement, Bureau of the Budget Circular A–49, dated February 25, 1959, appears in the appendix of this report. We have felt for some time that the departments and agencies had a real need for such a policy guide.

Numerous complaints in recent years that the Federal Government pay scale would not match that of private industry were solved by H.R. 9999, the Federal Employees Salary Increase Act of 1958. Not only did this act adjust the classified pay scale, but among other things, it eased recruiting efforts in certain skill areas by revising the entrance pay of college graduates. This legislation, we understand, already has reduced somewhat the turnover of professional Federal employees as well as aided the departments and agencies in their college recruiting.

The Government Employees Training Act, Public Law 85–507, recommended by our full committee, provides a comprehensive, governmentwide program for the training of Federal employees and will certainly represent an important step forward in the overall improvement of our Government personnel.

In view of the number of additional items in the missile program that are of interest to the Congress, we have recently asked the Comptroller General for a full investigation in certain designated areas with a detailed report to be made to our committee.[1]

The Department of Defense on February 16, 1959, was requested to review the subcommittee report for security clearance. On March 20, 1959, the Assistant Secretary of Defense, Hon. Charles C. Finucane, indicated the report was cleared for security purposes and also recommended certain factual changes. These suggested changes, both for security as well as fact, have been incorporated in the report.

Even though the subcommittee's investigation of manpower problems connected with the missile program is continuing, we are providing you this information, as developed by the subcommittee, due both to the timeliness and to the importance of the subject matter. This information, I believe, will be of interest and concern to members of the full committee and to the Congress.

With best wishes, I am

Sincerely,

JAMES C. DAVIS, *Chairman.*

[1] The letter from Chairman Davis to the Comptroller General follows on pp. V, VI, and VII.

HOUSE OF REPRESENTATIVES,
COMMITTEE ON POST OFFICE AND CIVIL SERVICE,
Washington, D.C., February 10, 1959.

Hon. JOSEPH CAMPBELL,
Comptroller General of the United States,
Washington, D.C.

DEAR GENERAL CAMPBELL: Under authority of House Resolution 139 of the 85th Congress our committee held hearings in December 1958 and one of the areas of interest related to the Defense Department's utilization of scientific and professional manpower in the missile programs. The committee staff prepared some background material for the hearings which has been furnished your office along with copies of the hearings. Under authority of House Resolution 78 of the 86th Congress our committee is continuing its inquiry into the manpower and related implications of the missile program.

In the course of the General Accounting Office study of missiles we would appreciate your developing for this committee information relating to several items which are within the area of this committee's responsibility.

We want to know the following about the Air Force long-range ballistic missile program:

(1) What standards have been and/or should be established by the Federal Government to determine the reasonableness and uniformity of fees in cost-plus contracts? For example, our hearings developed a noticeable difference in cost-plus fees as well as salaries paid by various missile contractors. Ramo-Wooldridge Corp. (now Space Technology Laboratories) was paid an average fee of 11.9 percent with average salary of key employees at $30,732. Applied Physics Laboratory (Johns Hopkins University) was paid an average of 4.6 percent fee and their average salary of key personnel was $15,540.

(2) Why was the Ramo-Wooldridge Corp. placed in such an indispensable position in Air Force's long-range ballistic missile operation?

(3) What has been the financial relationships between Ramo-Wooldridge, Thompson Products, Inc., and the Space Technology Laboratories?

(4) What personal gains have been made by key employees and former Government employees, military and civilian, in the Ramo-Wooldridge Corp., and Space Technology Laboratories as these corporations have become an integral part of Thompson Products, Inc.

(5) What is now the operating relationship of the Space Technology Laboratories, Ramo-Wooldridge Corp., and Thompson Products, Inc.?

(6) What contracts did Thompson Products, Inc., have during the past 5 years, either as prime or subcontractor to supply missile components for the Defense Department? Were any

of those contracts developed or reviewed by Ramo-Wooldridge Corp., or Space Technology Laboratories?

(7) Were any contracts, prime or subcontractor, awarded the Ramo-Wooldridge Corp. to produce hardware of any type for the Defense Department?

(8) Explain the relationship of the prime contractor for a long-range ballistic missile to the function of the Space Technology Laboratories. What do the STL personnel contribute that does not overlap and duplicate the efforts of the prime contractor or the Air Force staff?

As your office investigates other areas in the missile programs we would appreciate information on the following additional items.

(*a*) Cost-plus contracting procedures have resulted in practices by contractors of spreading costs over several contracts. The committee would like to know the reasons for this practice, approximately the extent to which it is being used, the degree of controls over items of cost, including personnel, and the effect of these practices on renegotiation of the contracts.

(*b*) Our committee noted that the publicly announced policy of the Defense Department, insofar as missle production is concerned, is one of parallelism and multiple approach. It would appear that with this approach there is reason to suspect unwarranted duplication in missile plans, components, and testing, either within the Federal Government, as between Defense contractors and the Federal Government or among Defense contractors.

(*c*) Our examination revealed that at one Defense activity, Holloman Air Force Base, Alamogordo, N. Mex., employees of cost-plus fee contractors were paid per diem allowances varying from $8 to $15 per day. This action has often proved a negative factor on the morale of Government personnel, without the per diem allowances but working alongside of the contractor's employees. It is also a factor among contractor employees who realize that they are not getting the same consideration under similar circumstances. In raising the question, we feel that this personnel practice may be pertinent to other places, and therefore, the overall policy and procedures are of sufficient interest for more complete development.

(*d*) The practice of private businesses, especially those working on Government contracts, of employing retired military officers, seems to be on the increase. For a recently retired officer to merely move from one side of the desk to the other, still dealing with the same subject matter, tends to create a doubtful atmosphere, if not a violation, of the Federal statutes. We are concerned with the responsibility which these retired officers and Defense Department have to themselves, and to the intent of the Congress, as expressed in several Federal statutes controlling the activities of retired or former officers dealing with the Federal Government.

(*e*) Civilian employees of the Military Establishment are being recruited by the Government-subsidized contractors. The Government, as a result of its procurement policies, is competing with itself. A review of the personnel practices of some of these Government contractors, including recruiting and training expenses, would appear in order. Also, an investigation of the military

departments' procedures to monitor these features in the contracts would be appreciated.

These are some of the items developed by our committee which have been a cause for concern to all the members. It is the feeling of the committee that the defense of our Nation transcends a unilateral approach to our mutual objective, getting the facts, and making an objective appraisal of the situation. Therefore, we are asking your assistance in this matter. It is possible that your office has already developed information in some of these areas. Consequently, we would like to be advised from time to time as the facts are developed.

We appreciate the fine cooperation of the General Accounting Office and its staff, especially in developing much of this information for the committee hearings. If more specific information concerning the several items raised is needed, our staff will be most willing to discuss it with representatives of your office.

With kindest personal regards, I am

Sincerely yours,

JAMES C. DAVIS,
Chairman, Subcommittee on Manpower Utilization.

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FOREWORD

This material was prepared for subcommittee use in public hearings December 1–5, 1958. It is a study of certain phases of the missile program in the Department of Defense.

During the public hearings, the representatives of the Department of Defense reported on the policies of the Department for contracting out defense work to private industry on a cost-plus basis; the effects of these policies on the Federal payroll; increased overall cost to the Government; and the contracting for services which normally and properly often are retained in and performed by the Department of Defense with its own personnel.

The testimony at these hearings tended to support the conclusions that there was room for improvement in the manpower utilization program in the Defense Department; that the Defense Department is using a multiple and parallel approach for missile production; that some firms on cost-plus contracts in research and development work were able to pay key engineering and scientific employees inflated salaries compared to those paid Federal workers in similar jobs; that some Federal employees have been hired from Government jobs by the high salaries made possible by cost-plus contracts; that there is a lack of standards against which Defense Department contracting officials can effectively monitor these contracts as to performance or expenditure; and that the practices of cost-plus contracting to "private industry" have tended to eliminate some of the basic elements of private enterprise, thus making it difficult to ascertain the specific difference between Government-operated installations and the cost-plus contractor, or so-called private industry.

Due to such factors as indicated above, many of these contracting practices may in the long run prove false economy, thereby costing the Federal Government more than otherwise would be the case. The contracting practices are also hurting the efforts of our Government to attract and retain the best possible personnel in vital programs.

The record also demonstrated the high quality of scientific and engineering personnel in Government who have the technical knowledge and abilities and have produced missiles. This ability is recognized in industry because of the higher salaries paid by Federal cost-plus contractors to hire them from Government.

The record also unfortunately showed that less than full utilization is being made of our scientific and engineering manpower in both the Federal Government and in private industry. Considerable effort is being directed to this problem, but as yet small headway has been made.

It is hoped that the full import of these practices will be explored beyond the manpower aspects by the committees of the Congress, the Department of Defense, the Bureau of the Budget, the General Accounting Office, and the newly organized National Aeronautics and

Space Administration so that better coordinated operating practices can result in greater economies and more effective defense. For example, during the hearings it was encouraging to hear that the Bureau of the Budget is developing criteria for the administration of defense contracts. This committee has also requested that the General Accounting Office, in their study of the missile program, emphasize the manpower aspects. This committee will continue to follow these developments and to examine the personnel practices and manpower policies of the research and development programs, especially the contracting out of responsibilities in such areas as missiles.

JAMES C. DAVIS,
Chairman, Subcommittee on Manpower Utilization,
Committee on Post Office and Civil Service.

DIGEST OF THE REPORT ON ASPECTS OF THE MISSILE PROGRAM IN THE DEPARTMENTS OF THE NAVY AND AIR FORCE

Missile Program and Its Impact on Government and Industrial Facilities

The magnitude of the impact of the guided missile programs on Government organizations, industry and industrial facilities, and national resources, including manpower, is tremendous and cannot be fully measured. It is recognized that the overall missile program today represents about 20 percent of the $42 billion of the 1959 defense appropriation. We do know that the Air Force Ballistic Missile Division received over $3 billion in 1955–58; North American Aviation Missile Division over $479 million in 1945–57; and the Department of the Navy paid Applied Physics Laboratories, Johns Hopkins University, over $105 million in 1945–57, and Bendix Aviation Corp. Missile Division over $221 million in 1945–57.

The missile program is nationwide, with hundreds of contractors spread throughout the country. Beyond the first tier of contractors are the subcontractors, and down the subcontract chain are the suppliers and vendors producing to schedules, and in many instances endeavoring to meet simultaneous demands of several missile contractors for material, equipment, or manpower from specialized but limited resources.

Although the missile programs are one of the big users of scientific-engineering personnel resources, it was our observation that the actual coordination of manpower requirements and supply for the missile programs has been left by the Office of the Secretary of Defense in most part to the individual military departments. This was especially apparent with respect to the role of the defense contractor as a user of manpower. The importance of manpower, particularly scientists and engineers, may not have been overlooked in the missile programs, but the impact on the missile industry and established Government facilities does not seem to be getting the necessary attention at top level of the Department of Defense to effectively coordinate the utilization of manpower among the Departments of Defense.

Coordination of Missiles by the Department of Defense

In discussions with officials of the Department of Defense about missile programs, many were of the opinion that some missiles seem to be in competition with each other and that multiapproach and parallelism were accepted facts. Actually, parallelism is being used as an incentive to encourage a competitive spirit between military departments. Navy and Air Force provided a list of missile programs for each department. They have at least 29 missiles (these are de-

scribed in more detail in the report). In this group of 29 missiles alone, there seems to have been ample opportunity to recognize the advantages of each missile and its components and to coordinate these advantages toward a common national defense effort instead of each group going their separate and independent way. For example, in several missile programs there is a research and development group working on most of the different components of the missile for that program—i.e., guidance, nose cone, etc. This has created a strong demand for scientific and engineering talent. It would appear that a sound organizational pattern would allow the full scope of the best available talent in the missile field to assess, evaluate, and integrate on a continuing basis all the now separate elements of the military and industrial research and development spectrum that can usefully contribute to more unified efforts in missile development. This would tend to eliminate much of the Department of Defense generated competition for the available resources, especially scientific-engineering talent required for their many missile programs. This is not a new concept. It was used in the development of one of the few guided missiles now an active part of our military forces in troubled areas of the world today—the Sidewinder missile. The Sidewinder is the end product of information obtained by a group of scientists from Naval Ordnance Test Station, China Lake, Calif., in their studies of many missile programs by their adapting these developments to a specific need.

The guided missile is a challenge to our defense concepts. Some see in it an entirely new method of defense efforts, others see in it the organizations which will conduct our space-age programs, while others maintain a more reserved attitude. Since World War II, missile projects have become the breeding spots for the creation and growth of organizations in Government and industry until they have become one of the big users of scientific-engineering manpower. In many cases this growth has been independent of the established organizations in industry and Government on what have been called crash programs.

For example, the organization of the missile program in the Department of the Navy has led to separate and at times competing programs between bureaus in Navy, especially the Bureau of Ordnance and Bureau of Aeronautics. BuAer and BuOrd have their separate and, at times, paralleling missile organizations. However, when Navy initiated their submarine missile launching program, they found it necessary in order to expedite the program to create still another missile program known as the Special Projects Office or the Polaris program. This Office, under the command of a rear admiral and staffed by some 250 handpicked civilian and military personnel, is administratively within the Bureau of Ordnance but bypasses normal review channels and is responsible directly to the Navy Ballistic Missiles Committee and the Secretary of the Navy. The Special Projects Office contains all the normal bureau functions—i.e., ordnance, aeronautics, ships, etc.—under a single coordinated command. It is the intention of the Navy to revert to normal management channels as soon as the need has passed—that is, the program solidly under way. To date the target date for return to normal operations has been extended several times.

An interesting sidelight on Navy's special projects operation was when the Polaris program selected an industrial firm to provide the technical advice and production facilities for the Polaris missile, they paid $35,000 to a management consulting firm for a survey of available facilities before selecting Lockheed Aircraft Corp.

In contrast to the divided missile program in the Navy, the Air Force has the Ballistic Missile Division at Inglewood, Calif., as a centralized organization to supply the development, test, production, and operational systems for the long-range ballistic missiles of the Air Force.

This program resulted in the establishment of an organizational complex composed of four different entities: Air Research and Development Command functions are known as the Ballistic Missile Division (BMD); Air Materiel Command functions are known as the Ballistic Missile Office (BMO); Strategic Air Command training and operational groups are known as SAC/MIKE; and a contractor, the Ramo-Wooldridge Corp., known as Space Technology Laboratories (STL). BMD provides overall project planning, management and draft operational concepts; BMO the necessary procurement and contracting services; SAC/MIKE the operational capabilities; and STL (Ramo-Wooldridge) the systems engineering and technical direction of the contractors.

The unique position of the Space Technology Laboratories in the Air Force ballistic missile complex should, if it has not already, become an indispensable cog in the Air Force management of their ballistic missile program. STL is responsible to the Air Force for systems engineering and technical direction for the Air Force Atlas, Titan, Thor, and some experimental ballistic missile programs. In addition, STL performs experimental work in system analysis. To perform these functions the Air Force is paying higher fees and Ramo-Wooldridge is paying higher salaries than those received by other organizations visited by the staff.

The organizational structure of the Ballistic Missile Division, Ballistic Missile Office, and Space Technology Laboratories provides that each of the three include overall management and integration of all aspects of a complete weapon system. Closely associated with the management of the weapon system in each of the three organizations are additional groups devoted exclusively to the components of the missile, including nose cone, propulsion, guidance, and control. These appear to be overlapping functions and consequent overstaffing.

The use of the missile program as a breeding spot for creation and growth of organizations has not been confined to Government. The Missile Development Division of North American Aviation Corp., Downey, Calif., is one of three divisions in the company engaged in missile work that, since 1948, grew out of a small nucleus known as the Aerophysics Department of the Los Angeles Division. Their principal project has been the Navaho missile which never fully developed even though the Air Force spent nearly $500 million on the program. At the time of our visit the division was in the process of negotiating new missile contracts with the Navy and the Air Force.

When Navy asked Bendix Aviation Corp. to produce the Talos missile, Bendix organized the Missile Division at Mishawaka, Ind.

It was noticeable that not only do we have many defense contractors conducting separate and independent research in fairly similar com-

ponent areas in missiles but also each military department has its own independent research and development operations. To some it is questionable if the need exists for the degree of separate missile research and development programs, each wearing different military uniforms and under different military commands. If such military requirements are needed, they feel it should be a more unified effort, not a carryover of the presently established divisions now compounding efforts to develop a sound missile program.

Assuming some of this research and development duplication is required, it has been apparent to the staff that the Office of the Secretary of Defense has been too late and provided too little unified leadership in the missile program. The Office of the Secretary of Defense and each of the services should become more cognizant of the missile programs in all the services and provide the leadership, organization, and direction necessary to prevent similar, parallel, or multiapproach programs such as exist in some current (and have existed in previous) missile research and development projects. However, it is apparent that since our committee's manpower hearings in November 1957, the Secretary of Defense has made considerable effort to improve this situation.

Problems in Personnel Administration

The subject of fees paid to contractors was mentioned by some Department of Defense representatives as having an effect on morale of employees because it would seem that the bigger the fee paid to contractors the higher the salaries paid to the employees. In examination we noted that over the 3-year period, 1955–57, the fee paid to Ramo-Wooldridge Corp. was more than double the amount of fee paid to other cost-plus-fee contractors visited by the staff in the missile study. The salaries paid by Ramo-Wooldridge were larger. The record shows that Ramo-Wooldridge received an average annual fee of 11.9 percent while three other contractors received fees of 5.7 percent (North American Aviation, Missile Division), 4.6 percent (Applied Physics Laboratory, Johns Hopkins University), and 5 percent (Bendix Aviation Corp., Missile Division). The average annual salaries of key employees of these organizations were:

Defense contractor	*Average annual salary of key employees*
Ramo-Wooldridge Corp. (STL), Inglewood, Calif	$30,732
North American Aviation, Missile Division, Downey, Calif	21,125
Applied Physics Laboratory, Johns Hopkins University (APL), Silver Spring, Md	15,540
Bendix Aviation Corp., Missile Division, Mishawaka, Ind	13,746

The average annual salaries of key civilian and military employees in Government installations visited by the staff were:

Air Force Ballistic Missile Division (ARDC), Inglewood, Calif	$13,528
Naval Ordnance Test Station (NOTS), China Lake, Calif	13,138
Air Force Ballistic Missile Office (BMO), Inglewood, Calif	12,334
Air Force Missile Development Center (AFMDC), Holloman Air Force Base, N. Mex	11,777

Other problems in personnel administration were:

(*a*) Technical professional employees in two Government installations were inadequately housed in terms of family size and qualitatively the situation was even worse (Naval Ordnance Test Station and Holloman Air Force Base).

(*b*) Incentive payments, including $9 per diem to employees of cost-plus-fee contractors occupying onstation buildings (Holloman Air Force Base).

(*c*) The creation of a Special Projects Office (Polaris program) in the Navy Bureau of Ordnance has a deleterious effect on other bureaus in the Department of the Navy.

(*d*) Officials of the Department of the Navy in Washington, D.C., stated that there were no significant manpower problems among scientists and engineers in Navy. Yet, information obtained elsewhere reveals that the Navy was: (1) Unable to obtain the quality of scientific and engineering personnel needed; (2) that approximately 50 percent of the young scientists and engineers obtained in one recruiting exercise resigned before completing 1 full year of service; (3) testimony by Navy representatives before this subcommittee indicated that at least one Naval installation had been losing a large percentage of GS–14 and GS–15 scientists and engineers (hearings on requests for more supergrades, June 1958).

(*e*) Lack of workload measurement techniques for research and development projects.

(*f*) The remote location of installations has caused personnel recruiting problems (NOTS and Holloman AFB).

(*g*) The military rotation policy in the Defense Department does not prohibit assignments of military personnel to tours of more than 3 to 4 years, especially on unusual or critical jobs. However, in some of the military activities visited, that were primarily engaged in missile work, the staff noted normal officer rotation practices, including several key military jobs not filled. Air Force allows a maximum tour of 5 years and that in research and development work.

The civilians, who act as the deputies to the officers, should be highly qualified. Records submitted by some installations indicated that there may be a lack of properly qualified civilian personnel in some of these key backup jobs, such as the Ballistic Missile Office, Air Force.

SUMMATION

1. The missile program is today one of the largest single items in our defense budget and it will continue to grow in size. At least 20 percent of the 1959 defense appropriation of $42 billion was for missile programs.

2. The announced policy for missile programs in the Defense Department has been multiapproach and parallelism with many different types of missiles; and to emphasize on a "crash" basis where necessary.

3. The Defense Department has procurement policies that have permitted considerable contracting out of technical, project, and management responsibilities.

4. It would appear that the defense efforts of the Government and industry are not fully utilizing our scientific and engineering manpower in the missile program. The net results accomplished to date could have been performed with less manpower under a more coordinated and practical policy.

5. The Government is competing with itself and with defense contractors for qualified employees.

6. Defense contractors are competing with the Government and with themselves for qualified employees.

36377—59——3

Section I.—Basis For Report

During the public hearings before the Manpower Utilization Subcommittee on November 4–7, 1957, the subcommittee received information indicating that some practices in Government contracting had led to waste in the utilization of scientists and engineers. A meeting was held between members of the subcommittee, its staff, and representatives of the Department of Defense, at which time the utilization of scientific and engineering manpower was discussed. Following this discussion, the subcommittee decided that the staff should develop certain specific information relating to the utilization of scientists and engineers in defense contracts for hearings by the subcommittee. However, in view of the area to be covered and the availability of a limited staff it was determined that a review should be confined to specific areas. A letter was sent to the Secretary of Defense on December 4, 1957 (see p. 41), outlining the areas of interest to the subcommittee and requesting the cooperation of the Defense Department in the review of missile materials.

The preliminary review developed certain manpower data regarding the Navy project Bumblebee in the Bureau of Ordnance, the Applied Physics Laboratory of Johns Hopkins University, Silver Spring, Md., and the Bendix Aviation Corp., Missile Division, Mishawaka, Ind. The subcommittee after reviewing the material, decided that comparative data from other missile programs in Defense was desirable and approved an expansion of the scope of the review. The Secretary of Defense was advised by letter in March 1958. (See p. 42.)

Such items as the following were developed for the subcommittee: comparison of staffing patterns; the loss of personnel by Government agencies to industry; the salary structures of positions in Government with those in industry, e.g., engineers and scientists, personnel officers, top management; the line of authority or direction from the Defense Department to the Navy Department to the bureaus and laboratories and to industry (the same for Air Force); turnover in personnel with reasons for the turnover, e.g., remoteness of station, poor housing facilities, better paying jobs in industry, etc.; workloads of different offices; possible overlap and duplication; and the effect of cost-plus contracting on these programs.

The subcommittee staff, in the development of data, studied a limited number of missile programs in the Department of the Air Force and Department of the Navy, and visits were made to the Naval Ordnance Test Center (NOTS), China Lake, Calif.; the Air Force Missile Development Center, Holloman Air Force Base, N. Mex.; the Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Md.; the Ramo-Wooldridge Corp., Los Angeles, Calif.; the Bendix Corp., Missile Division, Mishawaka, Ind.; and North American Aviation Corp., Missile Development Division, Los Angeles, Calif. As far as possible similar data was obtained from each of the places on staffing patterns, turnover of personnel. lines of authorities, workload, and cost-plus contracting.

SECTION II.—DESCRIPTION OF MISSILE PROGRAMS IN THE DEPARTMENTS OF NAVY AND AIR FORCE

Although the outline for the missile study necessarily limited the interest of the subcommittee to specific missile areas and programs, it was felt that the interrelation of these programs would be helpful in obtaining an overall perspective of the missile programs in the Departments of the Navy and Air Force. Therefore, during our study, a list was compiled by the 2 Departments of 29 missiles giving for each missile the identification, speed, range, propulsion, guidance, principal contractor, and current status. A summary of information shown on the list indicates that—

(*a*) There are 19 companies shown as prime contractors;

(*b*) Twenty missiles use rockets for propulsion, five turbojet, and three did not designate a propulsion system;

(*c*) Eight missiles have speeds of less than the speed of sound, four from the speed of sound to less than twice the speed of sound, five from twice the speed of sound to less than three times the speed of sound, six from three times the speed of sound to less than four times the speed of sound, and five without the speed shown; and

(*d*) Ten missiles have a range of travel up to 100 nautical miles, nine from 100 to 1,500 nautical miles, three from 1,500 to 5,000 nautical miles, five over 5,000 nautical miles, and one did not show the missile range.

In discussions with members of the Department of Defense about missile programs, many were of the opinion that some missiles seem to be in competition with each other; that multiapproach and parallelism were accepted facts. In this group of 29 missiles alone, there seems to be ample opportunity to recognize the advantages of each missile and its components and to coordinate these advantages toward a common national defense effort. For example, many of these missile programs have research and development groups working on components of the missile for that program, i.e. guidance, nose cone, etc. This has created a guidance research and development group, etc., for each of the programs in the departments. Also a further look at the list compiled by the departments show that in general usage missiles are classified by type according to location of target and location of launcher. Hence, a missile launched from the air (A) against a target on the earth's surface or sea, (S) is called an air-to-surface missile, or in abbreviated form, an ASM. Similarly, a surface-to-air missile becomes a SAM, a surface-to-surface missile is a SSM, and an air-to-air missile is an AAM. These departments have developed 8 ASM's, 4 SAM's, 12 SSM's, and 5 AAM's.

MISSILE POWER SYSTEMS

Generally speaking the power systems used in guided missiles are rockets, turbojets, or ramjets. In missile power systems, the Air Force and Navy have developed the following missiles in the same general power systems:

Power systems

Rocket (20)	Air Force (12)—Rascal, Bomarc, Navaho, Atlas, Titan, Thor, Jupiter, Snark, Goose, Matador, Mace, Falcon.
	Navy (8)—Corvus, Bullpup, Terrier, Tartar, Polaris, Subroc, Sparrow III, Sidewinder.
Turbojet (5)	Air Force (3)—Crossbow, Quail, Hound-Dog.
	Navy (2)—Petrel, Regulus I.
Rocket-ramjet combine (3)	Air Force (2)—Bomarc, Navaho.
	Navy (1)—Talos.
Rocket-turbojet combine (4)	Air Force (4)—Snark, Goose, Matador, Mace.
	Navy (0)—None.
Systems not designated (3)	Air Force (2)—WS 132A, WS 130A.
	Navy (1)—Eagle.

MISSILE SPEED OF TRAVEL

In missile speeds, the Navy and the Air Force have developed the following missiles in the same general speed range groups:

General speed range groups:	*Name of missile*
7	Air Force (6)—Crossbow, Quail, Snark, Goose, Matador, Mace.
	Navy (1)—Regulus I.
3	Air Force (0)—None.
	Navy (3)—Terrier, Tartar, Regulus II.
5	Air Force (2)—Hound-Dog, Bullpup, Bomarc.
	Navy (3)—Talos, Subroc, Bullpup.
7	Air Force (4)—Rascal, Navaho, Falcon, WS 130A.
	Navy (3)—Corvus, Sidewinder, Sparrow III.
1	Navy (1)—Polaris.
5	Air Force (5)—Atlas, Titan, Thor, Jupiter, WS 132A.

MISSILE RANGE OF TRAVEL

The Air Force and the Navy have developed the following groups of missiles with the same nominal range:

Group with same nominal range:	*Name of missile*
4	Air Force (1)—Falcon.
	Navy (3)—Bullpup, Sidewinder, Sparrow III.
2	Air Force (0)—None.
	Navy (2)—Terrier, Tartar.
4	Air Force (1)—Rascal.
	Navy (3)—Talos, Subroc, Eagle.
7	Air Force (6)—Crossbow, Quail, Hound-Dog, Bomarc, Matador, WS 130A.
	Navy (1)—Corvus.
2	Air Force (1)—Mace.
	Navy (1)—Regulus I and II.
3	Air Force (2)—Thor, Jupiter.
	Navy (1)—Polaris.
5	Air Force (5)—Snark, Navaho, Atlas, Titan, Goose.

MISSILE PRINCIPAL CONTRACTORS

The magnitude of the impact of the guided missile programs on industry and on industrial facilities is tremendous and can be measured in many ways, such as expenditures, manpower, facilities, resources, etc. For example, the Air Force has provided contractors participating in the program with industrial facilities amounting to $200 million from late 1954 to July 1957. This figure excludes invest-

ments at test sites. Contractors have also made substantial investments and have spent about $100 million of their own funds for industrial facilities during these years. For example, in the Polaris program of the Navy, initially Lockheed provided $4.2 million or 100 percent of the facilities. However, after the program is well underway the facilities provided by the Navy will have reached 55.7 percent of $34 million.

Beyond the first-tier prime contractors are the subcontractors, and down the subcontract chain are the suppliers and vendors producing to schedules and in many instances endeavoring to meet simultaneous demands of several missile contractors for material or equipment or manpower from specialized but limited resources. Some of these prime or principal contractors are:

	Contractor	*Missile*
1.	Applied Physics Laboratory	Terrier, Tartar, Talos.
2.	Bell Aircraft Co	Rascal, WS 130A.
3.	Boeing Airplane Co	Bomarc, WS 130A.
4.	Chance-Vought	Regulus I and II.
5.	Chrysler Corp	Jupiter.
6.	Convair Division of General Dynamics	Atlas, WS 130A.
7.	Douglas Aircraft Co	Thor.
8.	Fairchild Engine and Airplane Corp	Petrel, Goose.
9.	General Electric Corp	Sidewinder, WS 132A, Terrier, Tartar.
10.	Hughes Aircraft Co	Falcon.
11.	Lockheed Aircraft	Polaris, WS 130A.
12.	Glenn L. Martin Co	Bullpup, Titan, Matador, Mace.
13.	North American Aviation Corp	Hound-Dog, Navaho, WS 130A.
14.	Northrup Aircraft Co	Crossbow, Snark.
15.	Philco Corp	Sidewinder.
16.	Raytheon Manufacturing Co	Sparrow III.
17.	Republic Aviation Corp	WS 132A.
18.	Tempco A/C Corp	Corvus.

SUMMARIZATION

The guided missile is a challenge to our defense concepts. Some see in it an entirely new method of defense efforts, others see in it the organizations which will conduct our "space-age" programs, while others maintain a more reserved attitude. Since World War II missile projects have become the breeding spots for the creation and growth of organizations in Government and industry until they have become one of the big users of scientific-engineering manpower. In many cases this growth has been independent of the established organizations in industry and Government on what has been called crash programs. Although emergency programs can be justified, at times they have a history of high cost in resources including manpower.

To some of the people we talked with, especially scientific and engineering personnel, it is questionable if the need exists for the degree of separate missile research and development programs, each wearing different military uniforms and under different military commands. If such military requirements are needed, they feel it should be a more unified effort, not a carryover of the presently established land, sea, and air divisions now compounding efforts to develop a sound missile program. For example, in the many missile programs research and development groups are working on components of the missile for that program, i.e., guidance, nose-cone, etc. This has created a guidance research and development group, a nose-cone re-

search and development group, etc., for many of the missile programs in the Departments. A sound organizational pattern could allow the full scope of the best available talent in the missile field of each department to assess, evaluate, and to integrate on a continuing basis all the now separate elements of the military and industrial research and development spectrum that can usefully contribute to more unified efforts in missile development and, thus, eliminate much of the Department of Defense generated competition for the available scientific-engineering talent required for their many missile programs. This is not a new concept. It was used in the development of one of the few guided missiles now an active part of our military forces—the Sidewinder missile. The Sidewinder is the end product of information obtained by a group of scientists from Naval Ordnance Test Station, China Lake, Calif., in their studies of other missile programs and adapting these developments to a specific need.

Although the Department of Defense missile programs are one of the big users of scientific-engineering personnel, it was apparent that the coordinating of the scientific-engineering manpower requirements in the missile programs in operation today, or the missile programs under consideration for the future, has been generally left to the individual services. The importance of manpower, particularly scientists and engineers, may not have been overlooked in the missile programs but the impact on the missile industry does not seem to be getting the necessary attention at top level in the Department of Defense. It appears far too little effort is being directed to the manpower utilization practices of the defense contractors, particularly the subsidized cost-plus contractors.

Section III.—Description of Department of the Navy Missile Groups

In the Navy just about every major bureau has a part in the guided missile program. Bureau of Ordnance and Bureau of Aeronautics are primarily concerned with missile development. Bureau of Ships is concerned in launching and installation problems. Bureau of Personnel has the job of training personnel. The Office of Naval Research has the job of coordinating efforts in basic research and finally the whole program is operationally coordinated by the Director, Guided Missiles Division, under Deputy Chief of Naval Operations for Air. To go one step further, on the Department of Defense level, the research and development of guided missiles by all three services is coordinated by a Special Assistant to the Secretary of Defense for Guided Missiles.

The organization of the missile program in the Navy has led to separate and at times competing programs between bureaus in Navy, especially the Bureau of Ordnance and Bureau of Aeronautics. For example, once a missile program has been approved for production, and regardless of which organization in Navy developed the missile, it is assigned to the Bureau of Ordnance or Bureau of Aeronautics for production, e.g., if the missile is to be used by aircraft, it is assigned to the Bureau of Aeronautics or, if the missile is to be used aboard ship, it is assigned to Bureau of Ordnance. Both Bureau of Aeronautics and Bureau of Ordnance have their separate missile organizations operating under the overall Navy missile structure. However, there is still another missile program in the Navy known as the Special Projects Office or the Polaris program.

SPECIAL PROJECTS OFFICE

At one step below the Navy Ballistic Missile Committee and as an autonomous group the Navy has created the Special Projects Office to direct the technical development of the Fleet Ballistic Missile (FBM) weapon system, also known as the Polaris program. This Office, under the command of a rear admiral and staffed by some 250 handpicked personnel, is administratively within the Bureau of Ordnance though, as characteristic of the overall program, bypasses normal review channels and is responsible directly to the Secretary of the Navy and the Navy Ballistic Missiles Committee. The Special Projects Office contains all the normal bureau functions, i.e., ordnance, aeronautics, and ships, under a single coordinated command. It is the intent of the Navy to revert to normal management channels as soon as the need has passed—that is, the program solidly underway. To date the target date for return to normal operations has been extended several times.

The Navy FBM program was established in the fall of 1955 by directive of the Secretary of Defense and implemented by a Secretary of the Navy directive of November 17, 1955. The Special Projects Office was established to handle the problems of adopting a missile to shipboard environment with the associated problems of launching, handling, and navigation. Initially, the Army-developed liquid-propellent-missile "Jupiter" was to be used in the program but in 1956 the Department of Defense Joint Ballistic Missile Committee permitted the Navy to proceed independently on a solid propellant missile. With the Lockheed Aircraft Co., the Navy developed the solid propellent missile Polaris as a suitable weapon for the requirements of shipboard environments.

The staff of the Special Projects Office was recruited from other bureaus and offices of the Navy and from Government laboratories. Also we were told that the contractors were selected on the basis of their experience in the missile field, availability and competence of scientific and engineering personnel, and facilities available to perform the task as quickly as possible. Yet, when identifying the source of scientific and engineering manpower used by the program contractors, the Navy said contractors have hired, and it is expected that they will continue to hire, scientific and engineering personnel to meet the urgent needs of the Polaris program; the manpower curves of the principal contractors are now leveling off, and that the recent business recession has facilitated recruitment.

In regard to facilities available to perform the task as quickly as possible, at the end of calendar year 1959 the value of facilities provided by the principal contractor, Lockheed, will be $27 million or 44 percent of the total value of the facilities operated by Lockheed Corp. for development and production of the Polaris missile. Thirty-four million dollars, or 56 percent of the facilities will be Navy owned.

The cost of the Polaris program through fiscal year 1958 was $675,883,000, of which $239,567,000 was directly associated with the missile. The Congress provided additional funds for the Polaris program in the 1959 appropriations. In addition to the two Polaris submarines in the budget estimates, Congress included a total of $638,043,000 for four more submarines, equipment, and missiles. Among the items of cost in the initial stages of the Polaris program

was a fee of $35,000 to a management consulting firm to make a survey of industrial facilities to produce the Polaris missile. Based on this survey, Lockheed was awarded the contract.

OBSERVATIONS

In summary, the Special Projects Office was established outside the normal management channels and recruited personnel at the expense of other parts of the Navy and Government laboratories which should necessitate replacement in those bureaus and offices, thus stimulating costly personnel turnover. The principal contractor has hired, and it is expected that he will continue to hire, scientific and engineering personnel to meet the needs of the Polaris program, increasing the demand for qualified engineers and scientists. Although initially selected for available facilities, the principal contractor will be using facilities which are 56 percent owned by the Navy at the end of 1959.

It is questionable to the staff if the need exists for the separate missile organizations in Navy, each wearing different bureau labels and under different military commands. If such military requirements are needed, it should be a more unified effort, not a carryover of the presently established bureau system now compounding efforts to develop a sound missile program.

SECTION IV.—DESCRIPTION OF U.S. NAVAL ORDNANCE TEST STATION, CHINA LAKE, CALIF.

EARLY HISTORY OF ROCKET DEVELOPMENT BY NAVY

In 1939 a small group of U.S. scientists began to explore the potential of rockets for weapons. Using knowledge developed in the United States and in England, this group stimulated the interest of other scientists and rocket weapon potential became more widely recognized.

A rocket-accelerated-bomb project was first conducted by the Bureau of Ordnance (BuOrd) at the Naval Proving Ground (NPG), Dahlgren, Va. By June 1941 the Bureau of Ordnance research and development program had advanced to where a larger test area was required. The Naval Powder Factory (NPF), Indian Head, Md., was then used. By this time interest by the military was greatly intensified and rocket activities and facilities expanded.

The expanded rocket program headquarters were established at George Washington University for eastern operations, and at the California Institute of Technology (CIT) for western operations. BuOrd shifted its major attention to CIT in 1941, and CIT became almost exclusively a Navy-associated group working on surface- and air-launched rocket ordnance.

At CIT, under pressures generated with beginning of World War II, there developed an organization that blended civilian and military skills and produced a variety of antisubmarine and surface-to-surface rockets.

By 1943, as development interest swung more and more to aircraft rockets, initial plans were made by the Office of the Chief of Naval Operations and by BuOrd to obtain larger facilities. A survey was conducted and an isolated site was selected in the Mohave Desert,

near the village of Inyokern, Calif. Some of the principal factors in the selection of the Inyokern site were: ample area was available for various test firings; the area provided isolation required, yet was in reasonable proximity of major development and production activities in the southwestern United States (150 miles from Los Angeles); the existence of a small airstrip; excellent flying weather; availability of ample water and electric supplies.

A major building and construction program was undertaken to convert the isolated desert area to its new purpose. Personnel was transferred to Inyokern from the CIT group at Pasadena and from Goldstone Lake (near Barstow, Calif.).

In 1944 the first rocket-propellent-processing line was put in operation. In the same year the BuOrd with the Manhattan Engineering District constructed the Salt Wells pilot plant, where the processing of high explosives and the production of triggering mechanisms began in mid-1945. Also, in 1945 Dr. L. T. E. Thompson became the first civilian technical director of the station. (Dr. Thompson is now in the Polaris program as assistant to the director.) The National Defense Research Committee activities of CIT were gradually absorbed by the station prior to the end of World War II.

CONSTRUCTION OF MICHAELSON LABORATORY

As the wartime research and development and test staff grew, and as the construction of facilities advanced, attention was directed to the requirements of a long-range peacetime research and development program. The planning of a major research and development laboratory, which would serve as a focal point for all station activity, was considered. It was decided that, to insure complete job capability, the laboratory must be located on station at China Lake.

Construction of Michaelson Laboratory was started in 1944 and was completed in 1948. This laboratory became both the home and nerve center of the station's technical effort. From the variety of talent and devices housed within the laboratory comes the end products of research and development which then move out into the surrounding experimental and field test facilities for study and evaluation.

NAVAL ORDNANCE TEST STATION FACILITIES

Today the station exists as a complete functioning entity. Its facilities are capable of fully processing a weapon idea beginning with its embryo unit. Representing an investment in plant and facilities of over $200 million, the station covers an area of over a thousand square miles, containing within its borders complete laboratories, shops, explosive and propellent pilot plants, aircraft test ranges, sea ranges, captive-ground ranges, and a complete airfield. In addition, homes, schools, stores, hospitals and recreation facilities are provided for both military and civilian staff and their families. Over 12,000 inhabitants work and live in this self-contained community.

DESCRIPTION OF U.S. NAVAL ORDNANCE TEST STATION MISSION

The mission of the U.S. Naval Ordnance Test Station is to conduct research, design, development, limited production, test and technical evaluation of ordnance materials, components, assemblies, and sys-

tems, principally in the fields of rockets, guided missiles, underwater ordnance, and aircraft fire control, and to perform additional tasks as directed by the Bureau of Ordnance.

We were told that the mission of the U.S. Naval Ordnance Test Station is based on the philosophy that effectiveness in ordnance development is materially enhanced when research, development, test, evaluation and engineering for production are bound together in one closely integrated activity; also, that an indication of the impact of station effort upon service ordnance is the fact that most rockets in operational use by the U.S. Navy and the U.S. Air Force were developed by the U.S. Naval Ordnance Test Station.

ORGANIZATION AND STAFFING PATTERN

1. Summary of personnel by major functional occupation [1]

	1955				1956				1957			
	Civilian	Military	Total	Percent of total employment	Civilian	Military	Total	Percent of total employment	Civilian	Military	Total	Percent of total employment
Administrative personnel	450	25	475	8.8	475	25	500	9.1	500	25	525	9.5
Professional personnel	1,050	50	1,100	20.4	1,100	50	1,150	20.9	1,150	50	1,200	21.5
Supporting technical personnel	3,000	800	3,800	70.8	3,050	800	3,850	70.0	3,050	800	3,850	69.0
Total employment	------	------	5,375	------	------	------	5,500	------	------	------	5,575	------

[1] All figures are rounded, 1 year average estimates.

2. Salaries of key personnel

The average salary of key personnel was $13,138.

3. Grades of professional civilian department and division heads

Grade	Number of positions	Salary
GS-12	3	$8,810
GS-13	7	10,370
GS-14	39	11,835
GS-15	15	13,370
GS-16	1	14,670
Public Law 313	1	19,000
Public Law 313	1	15,000
Total	67	------

4. Total civilian employment turnover rates for 1955–57

[In percent]

	1955	1956	1957
Grand total	18.6	16.21	14.61
Professional	16.89	15.21	11.62
Subprofessional	25.33	19.14	18.97

The staff was told that within each major category (Classification Act groupings) there has been some increase in turnover at certain grade levels; however, this is primarily due to a stabilization of upper grade levels and a diminution of promotional opportunities.

At recent public hearings before this subcommittee, a representative of the Department of the Navy said:

> During the last 3-year period, losses at Naval Ordnance Test Station in positions at the GS–15 level and above have equaled 50 percent of all positions at those levels and losses of GS–14 equaled 30 percent of all GS–14 positions.

Inconsistencies between statements of officials in Washington and at the station were noticeable even by the Department of the Navy. When they were brought to the attention of the departmental personnel, a revised statement would be submitted to the subcommittee staff. The revision would tend to support the statements of the departmental personnel.

5. Turnover of key civilian administrative, professional, and supporting technical personnel

[In percent]

	1955	1956	1957
Key professional	14.2	13.8	13.2
Key administrative	0	41.6	17.6
Key supporting technical	16.6	0	0

The actual number of terminations and accessions of key administrative, professional, and supporting technical personnel for 1955 to April 1958 were:

	Terminations	Accessions	Average total employment [1]
Professional	190	61	1,100
Administrative	9	11	475
Supporting technical	1	0	3,017

[1] All figures rounded.

The staff was told that key professional employees terminate at the rate of about 13 percent per year. The accession rate for key professional employees of approximately 4.5 percent per year is the result of the station policy to promote from within to key position vacancies unless an applicant for appointment is clearly the best candidate.

All positions of key supporting technical personnel are filled by promotion, since their contribution is made primarily on the basis of long experience with the work of the station. The small turnover rate for key administrative employees is attributed to the recognition of their importance thus resulting in increased stature and stabilization of the group.

6. Results of a survey of terminated U.S. Naval Ordnance Test Station civilian employees at grades GS–12 and above for the 6-month period from July 1 to December 31, 1956

NOTS made a study in 1956 of the reasons for civilian employees leaving the station for new employment. This study showed for those employees terminated the maximum salary paid by private in-

dustry, the median increase paid by private industry, the dollar range of increase paid by private industry, and the reasons given by the respondents for leaving NOTS. A summary of this information indicated:

1.	Median increase paid by private industry		$1,242
	Upper quartile		2,500
	Lower quartile		800
2.	Range		100–9,000
3.	Maximum salary paid by private industry (now receiving $24,000)		22,000
4.	Breakdown of respondent group (number of respondents, 65):	*Number*	*Percent*
	(*a*) Received higher salary from private industry (81 percent employed by defense contractors)	47	72.3
	(*b*) Accepted lower salary with private industry (3 members of this group are now receiving considerably higher salaries than when employed by Government)	6	9.2
	(*c*) Went into own business	3	4.6
	(*d*) Were summer appointees	3	4.6
	(*e*) Accepted teaching positions	2	3.1
	(*f*) No salary mentioned	2	3.1
	(*g*) Left to resume education	1	1.5
	(*h*) Employed by State government	1	1.5

FUNDING AND PROJECTS FROM FISCAL YEAR 1955 TO DATE ACCORDING TO PRINCIPAL CATEGORIES

A summary of NOTS principal sources of funds and principal obligations were defined as follows:

1. Principal sources of funds

[In millions of dollars]

	Fiscal year 1955	Fiscal year 1956	Fiscal year 1957	Fiscal year 1958
Navy Bureau of Ordnance	39.2	43.1	40.6	43.3
Other Navy	2.1	3.8	6.7	8.3
Other agencies	2.0	2.8	4.5	2.4
Military pay	2.2	2.5	2.5	2.5
Total	45.5	52.2	54.3	56.5

2. Major budget categories

[In millions of dollars]

	Fiscal year 1955	Fiscal year 1956	Fiscal year 1957	Fiscal year 1958
Projects [1]	36.7	41.8	43.5	43.9
Basic maintenance	3.5	4.9	4.8	4.8
Minor capital	2.5	2.3	2.9	4.7
Military pay	2.2	2.5	2.5	2.5
Miscellaneous	.6	.7	.6	.6
Total	45.5	52.2	54.3	56.5

[1] A further breakdown of this item is shown in table (3).

3. Project obligations by major-program areas:

[In millions of dollars]

	Fiscal year 1955	Fiscal year 1956	Fiscal year 1957	Fiscal year 1958
Salt Wells pilot plant and major weapons systems [1]	20.8	26.0	27.3	28.5
Supporting or applied research and components	6.8	7.3	6.8	7.0
Evaluation and services	6.9	6.0	6.9	6.2
Foundational research	1.8	2.0	2.0	1.8
All other	.4	.5	.5	.4
Total	36.7	41.8	43.5	43.9

[1] Prior to fiscal year 1955 the operations of the Salt Wells pilot plant cost between $4 to $5 million per year.

The staff was told that the station's technical program is composed at present of 305 individual work assignments comprised of 160 task assignments and 145 local projects. The planned accomplishment of this work requires over 1,900 man-years of direct effort each year. This number of man-years is consistent with the present size and makeup of the organization. The station was said to be near the optimum size to pursue its assigned research and development mission effectively. The overall program does allow the full utilization of present organization and manpower, even though fund limitations, procurement lead time problems, etc., occasionally tend to reduce the level of effort on a few programs to a minimal level.

When discussing work measurement techniques for scientific personnel, we were told that a competent research and development group can generate ideas many times faster than the ideas can be pursued. This makes it difficult to state that 100 percent effectiveness can be obtained from a scientist or engineer, especially when reference is being made to ideas as products; also, when negative results as well as positive results offer value to a research and development operation, the effectiveness of personnel or the organization becomes difficult to assess.

In the files of the subcommittee are charts on the status of all major technical programs on a monetary and time basis.

OBSERVATIONS

Although the remote location of the station and desert living may appeal to some prospective employees of the station, they have created recruitment problems. This, coupled with the substandard and inadequate housing problems plus the attraction of higher salaries from defense contractors, has been a problem in the obtaining and retention of qualified personnel. However, there is a corps of highly qualified and even outstanding personnel at the station who seem to be dedicated to the work they have been called on to do and expect to remain at the station as long as these assignments are given to the

station. There was some concern expressed about the future assignments for the station, especially since the creation of such organizations as the Special Projects Office within the Bureau of Ordnance. If Navy is to retain this corps of qualified personnel, officials in the Department at Washington will have to utilize the potentialities of this corps more than they appear to be doing at the present time.

The station has a record for producing guided missiles. Some are "Rat," "Zuni," "Subroc," and "Sidewinder." Sidewinder was referred to as the "recalcitrant" because it was developed by personnel at NOTS without offical sanction. It is now assigned to fighting forces in many areas, such as the Middle East and Formosa.

Section V.—Description of Air Force Missile Development Center, Holloman Air Force Base (ARDC), N. Mex.

EARLY DEVELOPMENT OF AF MISSILE DEVELOPMENT CENTER

The Air Force Missile Development Center (AFMDC) is located in the Tularosa Basin, 10 miles west of Alamogordo, N. Mex., in south-central New Mexico, and it is integrated with the White Sands Proving Ground, Las Cruces, N. Mex., which borders on the south.

The center is a part of the Air Research and Development Command (ARDC). The programs and resources planning of Research and Development are handled directly between Headquarters, ARDC, Andrews Air Force Base, Md., and the center. The Weapons Systems Project Office, Det. 1, Wright Air Development Center, Dayton, Ohio, directs all the Weapons Systems programs at the center.

The origin of what is now AFMDC began in 1941 as a proposed establishment for British overseas training programs but within 1 year became the Alamogordo Army Airfield, a United States bombing crew training base. It was here that the first atomic explosion in history occurred in the northwest corner of the Alamogordo bombing and gunnery range in July 1945.

In 1945 the development of the Air Force guided missile test program started at Wendover Field, Utah, under the Air Materiel Command. This group has been described as the major portion of the Air Force embryonic guided missile program.

In 1947, Alamogordo Army Airfield came under the jurisdiction of the Air Materiel Command in exchange for Wendover Field. AMC moved its personnel and facilities to Alamogordo. Activities expanded in missile projects, drones, radio-controlled bombs, various electronic and upper-atmosphere investigations, and parachute recovery devices. Among the earlier test projects were the NATIV, a prototype for the Navaho[1] intercontinental ballistic missiles and the Snark, another ICBM, and the Matador, which became the first tactical surface-to-surface missile displayed overseas by the Air Force; the Atlas,[1] another ICBM, which was later halted for several years and then accelerated elsewhere as a crash program and the Aerobee,[1] a high altitude research rocket.

When the Air Force became a separate branch of the service with the Army and Navy, Alamogordo Army Airfield was renamed Holloman Air Force Base in honor of the late Col. George V. Holloman, who had been active in military technical research and development.

[1] Further described in another section of this report.

AF MISSILE DEVELOPMENT CENTER AS A FUNCTION OF ARDC

In April 1951 jurisdiction over Holloman Air Force Base shifted from the Air Materiel Command to the then recently created Air Research and Development Command. In September 1952, Holloman test range was integrated with the White Sands Proving Ground where the various services were coequal users, although administrative range responsibilities were assigned to the local Army commander. The integrated range covers an area of about 100 miles by 40 miles excluding the corridor to Wendover Air Force Base, Utah. The corridor has a length of 600 to 700 miles.

In October 1952, Holloman was designated full center status and became Holloman Air Development Center. In September 1957 the center was redesignated the Air Force Missile Development Center. As the Holloman program continued its expansion, the physical resources also increased. Instrumention on the range has expanded. The AFMDC electronic computer capability is largely installed and is said by the center to be the most complete within the entire Department of Defense. The high-speed test tract has been extended to 35,000 feet and is said by the center to be the longest test tract known to exist, exceeding the length of the test tract at Edwards Air Force Base, Calif., and Navy's tract at NOTS, China Lake, Calif. Also included in the expansion program has been a railroad spur line, scheduled airline service, 73 miles of pipeline for water supply, and new electric powerlines.

PERSONNEL

Personnel at AFMDC also increased. The total assigned military and civilian personnel has risen each year without exception during the past 10 years as have totals for contractor employees and the grand total of working base population, including various attached military units, base exchange workers, and employees on nonappropriated fund activities.

In addition to the programs for missiles and drones at the center, there have been increased programs in biodynamics, the physiology of rocket flight and space biology by the aeromedical laboratories. These programs are related to escape from high-speed aircraft, cosmic radiation hazards. effects of subgravity, space chamber environments, human reentry of atmosphere, and automotive and aircraft crash forces.

As part of the research and development programs at the center, scientists are employed on a per diem basis to make studies on selected technical areas. Scientists usually selected from the faculties of universities are employed during summer months at $50 per diem, plus $15 per diem expense allowance. This group is housed at a lodge in the Sacramento Mountains, about 30 miles from the center, which permits these outstanding scientists to live in their own "scientific community." Liaison is maintained between the group and the scientists working at the center. They work under the direction of the chief scientist of the center. The center employs about 40 scientists in their "scientific community."

Another project under discussion at the center, and with the Air Force, is the "solar furnace." The plans call for self-contained units,

located in the Sacramento Mountains, to make solar studies. Costs for this program are not known.

Missile program contractors maintain facilities at the center. During the past year there were 15 contractors located on the base. They employed 1,108 people with an annual payroll of over $8½ million (median income, $7,850) with facilities totaling $107 million. We were told that lack of uniform procedures in incentive and per diem allowances paid employees of contractors and the Government, both military and civilian, created morale problems. As an example, employees of contractors at the center were paid a per diem allowance in addition to salary but the Government employees were not paid the per diem allowance. The contractor per diem allowance averaged $9 per day and until recently they were provided with living quarters at the center, the same as Government employees. We were told that some of these employees have been receiving per diem payments for 5 years, even though the opinion of the Comptroller General on the subject of temporary-duty status places a reasonable time limitation as 5 months.

TURNOVER OF PERSONNEL

Resignations and transfers of professional and scientific employees do not present a problem at this base.

Between April 1, 1957, and March 31, 1958, only 16 employees in grades GS–12 and above left Holloman. Four employees left to accept positions with Aero Physics Corp. of Santa Barbara, Calif., for sizable increases in salary. Two of the positions were filled from within. One position was canceled and one position, that of technical director, was filled by the appointment of a former consultant to the station.

PROFESSIONAL CIVILIAN PERSONNEL GS–12 AND ABOVE

Grade	Number of positions	Salary
GS–12	38	$8,810
GS–13	43	10,370
GS–14	29	11,835
GS–15	6	13,370
GS–17	1	15,855
Public Law 313	1	17,050
Total	118	

SALARIES OF KEY PERSONNEL

The average salary of key personnel was $11,777.

OBSERVATIONS

Today the Air Force Missile Development Center, Holloman Air Force Base, N. Mex., has the status of a full development center. The investment in plant and facilities amount to about $30.7 million, plus $107 million for contractor facilities, and covers an area of 8,691 acres, excluding the range which is part of the integrated range at White Sands Proving Ground at Las Cruces, N. Mex. The center provides research and development related to tests on guided missiles and allied

equipment in support of the Air Research and Development Command. They also conduct research and development in space biology and electronics as well as provide facilities and support for civilian contractors, colleges, and Government agencies to provide research and development operations. In addition, homes, schools, stores, hospitals, and recreation facilities are provided for both military and civilian personnel and their families. In this self-contained community there are 3,600 inhabitants.

This is a rapidly expanding operation whose full utilization of facilities seems difficult to establish. There is a nucleus of scientists obtained from Germany after World War II who had experience with the development of rockets for Germany. However, the effectiveness of their work is difficult to evaluate and so far as we could determine headquarters Air Research and Development Command does not have an effective system for evaluation though we were told that the matter was under consideration. [1]Although the turnover of personnel at the station was low some of the areas of concern to personnel were the substandard and inadequate housing; the average salary of key personnel at Holloman; defense contractor personnel at the station receiving a per diem allowance while working at the station, regardless of the number of years they have been assigned to the station.

SECTION VI.—DESCRIPTION OF THE MISSILE DEVELOPMENT PROGRAM IN THE AIR FORCE AND THE AIR FORCE BALLISTIC MISSILE DIVISION (AFBMD), INGLEWOOD, CALIF.

The Air Force Ballistic Missile Division at Inglewood, Calif., is a centralized organization, started July 1, 1954, to supply the development, test, production, and operational systems for the long-range ballistic missiles of the Air Force.

A. ORIGIN OF PROGRAM

The origin of the Air Force long-range missile program dates from 1946 when the Army Air Corps instituted study and development projects for long-range missiles. In that year the Army Air Corps established study projects aimed at development of rocket-powered ballistic missiles. Contracts were negotiated with North American Aviation for rocket propulsion and long-range missiles development (Navaho),[1] and with Consolidated-Vultee Aircraft (now Convair Division of General Dynamics Corp.) for study and investigation of missile guidance and control, rocket engine swivel and lightweight missile structures.

In 1951 the original Atlas project, a 5,000 mile ballistic missile, was instituted by the Air Force and a contract was awarded to Convair. In the years from 1951 to 1954, Atlas progressed from the feasibility stage to limited hardware development. The project was twice reviewed and approved by a committee of the Air Force Scientific Advisory Board but progress was limited by the technical problems connected with development of the missile (i.e., guidance, nose cone, reentry, propulsion, lightweight missile structures, etc.).

In 1953 several factors influenced the Atlas program and led directly to the present expanded and accelerated missile program in the Air Force. The first of these factors was the so-called, thermo-

[1] Navaho is further described in another section of this report.

nuclear breakthrough, the announcement in mid-1953 by Atomic Energy Commission that small, lightweight, high-yield weapons could be produced within a few years.

1. Von Neumann Committee (SMEC) [1]

The implications of this advance on missile warhead weight, required guidance accuracy, missile gross weight, and propulsion system requirements, highlighted the reports issued in 1954 by the Rand Corp. of Santa Monica, Calif., and the Air Force Strategic Missiles Evaluation Committee (SMEC) sometimes called the Teapot or Von Neumann's Committee. These reports were basic to the Air Force decision to reorient and accelerate the Atlas and the ICBM programs.

The SMEC report was critical of the existing Atlas program. It recommended that—

(*a*) A new development-management group be created to devise and direct a redirected, expanded and accelerated Atlas program;

(*b*) the new program should have increased financial support and high project priority;

(*c*) Atlas military specifications should be relaxed in light of new warhead technology; and

(*d*) if these recommendations were adopted and the development-management group was relieved of excessive detailed regulations, ICBM operational capability could be attained in 6 to 8 years (1960–62), 3 to 5 years earlier than existing Atlas objectives.

The SMEC also expressed doubt concerning features of the Atlas program and urged halt of the Convair Corp. production engineering pending program restudy and reorientation. The Rand report, more strongly on the technical side, confirmed and backed up the SMEC recommendations.

2. Review of Von Neumann Committee recommendations

In the light of SMEC and Rand recommendations the Air Council (the Council functions as an advisory group to the Chief of Staff, USAF), reviewed the Air Force missile program in March 1954 and recommended that the Atlas program be reoriented to achieve the early establishment of an ICBM; that the project acceleration be limited only by technical progress; and that field responsibility for the project be assigned to the Commander Air Research and Development Command (ARDC); that the Commander of ARDC, "* * * be directed to establish within his organization a military-civilian group with the highest possible technical competence in this field * * *" which would within one year recommend in full detail a redirected, expended, and accelerated program.

[1] SMEC was established in October 1953 as a result of action of an earlier Department of Defense Study Group on Guided Missiles (June 1953) which recommended that the Air Force intercontinental missiles program be examined by a special committee. The SMEC was composed of scientists headed by Prof. John von Neumann, then with Princeton Institute of Advance Studies and later Commissioner of AEC. The SMEC also included Dr. Louis G. Dunn, formerly of California Institute of Technology but presently with the Ramo-Wooldridge Corp. When the Air Force was asked if Drs. Ramo and Wooldridge were members of SMEC they told the subcommittee, "Drs. Ramo and Wooldridge served the committee as technical experts under Air Force contract with their corporation, but for all practical purposes could be considered to have been members much of the time the Strategic Missiles Evaluation Committee was in existence (November 1953–February 1954). They resigned from the Strategic Missiles Evaluation Committee immediately after the February 1954 study and recommendations." Other members of the SMEC are shown on the list supplied by the Air Force appearing in the appendix to this report.

3. AF guided missile office established

The Office of Assistant Chief of Staff, USAF, for Guided Missiles (AFCGM) was established in April 1954 as the central point of contact on guided missile matters, with responsibility for control and direction of these programs at Headquarters, USAF. The following month this office was given the responsibility for central control and direction of guided missile affairs for the AF Chief of Staff, and directed that the Atlas program would be accelerated to the "maximum extent that technological development will permit," and be given "the highest program priority in the Air Force."

4. AMC and ARDC establish Western Development Command

ARDC established a field office on the west coast of the United States under a general officer, having authority and control of all aspects of the program encompassing development of the complete weapon system, including ground support and the development of recommended operational, logistic and personnel concepts.

The Air Staff directed that—

1. Procurement responsibility for the project would remain with the Air Materiel Command and AMC was directed to provide procurement support at the field offices;
2. Direct communication between the field office, major commands, and Headquarters, USAF, was authorized.

This field office was established as the Western Development Division, Headquarters (WDD) on July 1, 1954. The name of the organization was changed to Air Force Ballistic Missile Division (AFBMD) on June 1, 1957. Brig. Gen. B. A. Schriever assumed command of Western Development Division in addition to his assignment as assistant to the commander, ARDC. ARDC and AMC agreed on the division of project responsibilities and AMC established a special procurement contracting agency, the Special Aircraft Project Office, Directorate of Procurement and Production, at the Western Development Division in August 1954. The name of the organization was changed to the Ballistic Missile Office (BMO) in March 1956. Brig. Gen. Ben I. Funk became Deputy Director of BMD and in charge of the BMO operations on March 15, 1956.

5. Ramo-Wooldridge contract

The Ramo-Wooldridge Corp. (R–W) had supported the SMEC in its study of the ICBM during late 1953. In support of SMEC recommendations, R–W had recommended a 12-month program of technical evaluation and system analysis of the Atlas project. R–W became the choice to perform the studies recommended by Rand and SMEC. A letter contract of May 17, 1954, called for R–W to "perform technical services and furnish necessary personnel, facilities, and materials to conduct long-range analytical studies of weapon systems," and to submit reports thereon. Thus, R–W was to provide facilities, services and technical support for WDD—the Air Force agency which was to manage the ICBM program.

6. Strategic Air Command enters program

After the assignment of the responsibilities for the "initial operations capability" (IOC) to AFBMD (1955), the ballistic missile program became an integrated development, operational program, with one agency given total weapons system responsibility through the production and readiness of complete operational ballistic missile systems.

This was an integrated approach in development-test-production-operational areas. The IOC phase is managed by SAC/MIKE, a new organization which had not been staffed at the time of our visit.

7. Program expedited and expanded

The program was given the highest priority in the Nation by the National Security Council (September 1955) and special program approval procedures were established (November 1955), by the Department of Defense and the Department of the Air Force after a study by a special committee headed by Mr. Hyde Gillette, then Deputy for Budget and Program Management, Office of the Assistant Secretary of the Air Force for Financial Management.

The program, expediting procedures adopted by DOD and USAF as a result of the study, created two Ballistic Missile Committees, one at USAF and one at the Department of Defense. These Committees composed of interested Assistant Secretaries and chaired by the Secretary of the Air Force and DOD, Director of Ballistic Missiles, respectively, were given review and approval authority over the entire program.

After the first year the program which originally consisted of the Atlas project was greatly expanded with addition of other ballistic missile weapon systems in 1955, 1956, and 1957. These systems have generally been identified as (1) Atlas; (2) Titan (May 1955); (3) Thor (November 1955); (4) Pied Piper (July 1956); (5) Minuteman (April 1957); (6) Jupiter (reassigned from Army, December 1957).

8. Expenditures and personnel

The ballistic missile weapon system has integrated the development, test, and operational areas with the production of operational weapon systems. The program has become the single largest military program ever undertaken by the Nation. In addition to the 2,900 personnel in the AFBMD complex, 47,000 people are employed by associate contractors and at least double that number by subcontractors. During fiscal year 1955 through fiscal year 1958 over $3 billion has been authorized for all phases of the program. The Air Force calls this program, "The Scientific-Industrial-Military Development Complex."

9. Observations

In effect the Air Force ballistic missile program resulted in the establishment of an organization "complex" composed of four organizational entities, Western Development Division (WDD—now known as Ballistic Missile Division, BMD); Ramo-Wooldridge Corp. (R-W, now known as the Space Technology Laboratories of Ramo-Wooldridge Corp., STL); Air Materiel Command (AMC, now known as Ballistic Missile Office, BMO); and the Strategic Air Command Training and Operational Group known as SAC/MIKE. BMD provides overall project planning, management, and draft operational concepts; STL the systems engineering and technical direction of the contractors; BMO the necessary procurement and contracting services, and SAC/MIKE the operational capability.

The organizational structure of the Ballistic Missile Division, Ballistic Missile Office, and the Space Technology Laboratory indicate overlapping responsibilities and consequent overstaffing.

For example, in the case of Atlas, a representative weapon system, the responsibility of each of the three organizations in the Ballistic

Missile Division complex includes overall management and integration of all aspects of a complete weapon system. Closely associated with the management of the weapon system in each of the three organizations are additional groups devoted exclusively to the components of the missile, including nose cones, propulsion, guidance, and control. The latter groups are identified as the Aeronautics and Electronics Laboratories in the Space Technology Laboratory, the Subsystem Division in the Ballistic Missile Office; and Nose-Cone, Propulsion, and Guidance and Control Divisions of the Ballistic Missile Division.

The organization and staffing referred to above is identical for the Titan and Thor missiles and could be expanded to the newly assigned missiles.

B. AIR FORCE BALLISTIC MISSILE DIVISION, HEADQUARTERS, AIR RESEARCH AND DEVELOPMENT COMMAND, INGLEWOOD, CALIF. (BMD–ARDC)

1. Mission

The mission of the Air Force Ballistic Missile Division (BMD) is to develop ballistic missile weapon systems and those space weapon systems directed by Headquarters, Air Research and Development Command. This mission includes support weapon systems and all planning necessary to the initial operational capability (IOC). In coordination with other commands at Inglewood, it encompasses system integration and other actions necessary to accomplish logistic support, training, facility, and other operational planning to insure the IOC at the earliest possible date.

In summary, this is the division through which the Air Force would retain overall system responsibility for the Air Force ballistic missile programs and contracted with Ramo-Wooldridge Corp. for a technical and scientific staff. Together with their counterpart of the Air Force Ballistic Missile Division, the Ramo-Wooldridge technical and scientific personnel were integrated into a development-management program.

Maj. Gen. Bernard A. Schriever is now and has been the commander, Ballistic Missile Division, Headquarters, Air Research and Development Command since its inception.

2. Salaries of key personnel

The average salary of key personnel was $13,528.

C. BALLISTIC MISSILE OFFICE, AIR MATERIEL COMMAND, AIR FORCE BALLISTIC MISSILE PROGRAM, INGLEWOOD, CALIF. (BMO–AMC)

1. Mission

The Ballistic Missile Office (BMO) is the Air Materiel Command (AMC) component of the Air Force Ballistic Missile Complex in Inglewood, Calif. This organization performs the normal range of Air Materiel Command functions on an expedited basis, i.e., the procurement and production, supply, maintenance engineering, quality controls and transportation in coordination with Headquarter, AMC, directorates and staff offices with Air Materiel areas (AMA) and Air Force depots (AFD), for the Air Force missile program. The office is different from any other AMC headquarters components in that its mission embraces all material support functions in the command mission.

Maj. Gen. Ben I. Funk has been in command of the BMO since March 15, 1956.

2. Salaries of key personnel

The average salary of key personnel was $12,334.

	Grade	Salary
Atlas–WSPO:		
Chief (vacant)	Colonel	$13,140
Supervisory procurement production officer	GS–14	11,835
Titan–WSPO:		
Chief (vacant)	Colonel	13,140
Supervisory procurement production officer	GS–14	11,835
Thor–WSPO:		
Chief (vacant)	Colonel	13,140
Supervisory contract specialist	GS–14	11,835
117L–WSPO:		
Chief	Lieutenant colonel	10,860
Supervisory contract specialist	GS–13	10,370
Minuteman–WSPO:		
Chief	Lieutenant colonel	10,860
Supervisory contract specialist	GS–12	8,810
Jupiter Project Office:		
Chief	Lieutenant colonel	10,860
Deputy Chief	Major	9,336

3. Qualifications of civilian personnel (BMO)

In the Ballistic Missile Office there are 77 positions of grades GS–12 and above. These are the positions, it is assumed, on which the military officers in charge rely. However, records submitted by the Ballistic Missile Office indicate that there may be a lack of properly qualified people in these executive-type positions. The records show of the 77 positions there are 20 vacancies

The educational qualifications of the 57 people occupying these executive-type positions are as follows:

	Percent
Degrees	35
2 years of college	26
Less than 2 years of college	16
High school	23

This means that approximately 39 percent of the 57 people occupying executive-type positions have less than 2 years of college training. Twenty-three percent of these 57 people have only a high school education. It would seem that Air Force standards are extremely low or qualified people are simply not available.

4. BMO educational qualifications of civilian employees, GS–12 and above

BMO had 57 employees in GS–12 and above. Educational qualifications are as follows:

Education	GS–12	GS–13	GS–14	GS–15	Total	Percent of total
Degrees	7	10	3	0	20	35
2 years college	7	5	1	2	15	26
Less than 2 years college	4	0	4	1	9	16
High school	8	3	2	0	13	23
Total	26	18	10	3	57	100

Less than one-fourth of the employees holding top jobs (GS–14 and 15) in procurement in BMO have college degrees.

5. Turnover in key military positions in Ballistic Missile Office

The Ballistic Missile Office reports 36 military officers in key positions including 4 vacancies and 1 officer on TDY status. According to rank they are graded as follows:

Major general	1
Colonel	5
Lieutenant colonel	16
Major	8
Captain	1
Total	31

The Ballistic Missile Office was activated on August 15, 1954, and its total staffing between August 1954 and April 25, 1958, was as follows:

Date	Military	Civilians	Total
Aug. 15, 1954	3	7	10
Oct. 15, 1955	7	29	36
Mar. 31, 1956	9	44	53
Dec. 31, 1957	52	146	198
Apr. 25, 1958	127	242	369

6. Rotation of military officers

The chart below shows the EOD (entrance on duty) dates for the 31 key military officers:

Months	1956	1957	1958
January			2
February	1		1
March	2		1
April	4		
May	2		
June	2		
July	6	2	
August	1	1	
September	1		
October		1	
November	1		
December	2	1	
Total	22	5	4

Information submitted by the Ballistic Missile Office after our visit to Los Angeles disclosed that there are 31 military officers assigned to the Ballistic Missile Office. Twenty-two of the thirty-one officers entered on duty during 1956, five entered on duty in 1957, and four entered on duty in 1958.

The matter of rotation is of importance to the administration of the missile program in the Department of Defense in that the Air Force regulations 35–11 provides a minimum period of 3 years and a maximum period of 5 years at a specific Zone of Interior location. However, in some installations included in our visit, officers were rotated more frequently and therefore the civilians who act as the officers' deputies should be highly qualified individuals. However, at BMO, 39 percent of the civilians occupying executive-type positions have less than 2 years of college training.

7. Civilian job vacancies in Ballistics Missile Office

There are 20 reported vacancies in BMO. Nineteen vacancies are grade GS–13 and one GS–12. The record submitted by BMO shows that these vacancies are not due to inability to obtain personnel but are newly established positions. Between December 31, 1957, and March 31, 1958, civilian strength authorizations were increased from 155 to 256, of which 56 were grades GS–12 and above.

D. SAC/MIKE, INGLEWOOD, CALIF.

1. Mission

The assistant commander in chief, Strategic Air Command (SAC/Mike), represents the Commander in Chief, Strategic Air Command, on the AFBMD/BMO SAC/Mike Research and Development Executive Management Complex at Inglewood, Calif. He establishes plans and requirements for all operational aspects of the ballistic missile and space weapon systems assigned to the Strategic Air Command.

SAC/Mike is a new part of the Ballistic Missile Division Complex and has established one base, Cooke Air Force Base, Calif. A second base, Francis E. Warren Air Force Base, Wyo., is also being prepared for operational use and actions are under way for other operational bases in Colorado and elsewhere.

SECTION VII.—DESCRIPTION OF THE ORGANIZATION AND MISSION OF THE RAMO-WOOLDRIDGE CORP. OF INGLEWOOD, CALIF.

ORGANIZATION

The Ramo-Wooldridge Corp. was formed in September 1953 as a corporation for the purpose of conducting research, development, and manufacturing operations in the field of electronics systems for commercial and military applications and in the field of guided missiles. The corporation is organized in two principal branches: The General Electronic Group (the operating divisions engaged in development and manufacture of control systems, communication systems, and other electronic hardware) and the Space Technology Laboratories (STL) (engaged in research and development in ballistic missiles and space technology).

EXPANSION OF OPERATIONS, SPACE TECHNOLOGY LABORATORY ESTABLISHED

Four years ago the Ramo-Wooldridge Corp. established its Guided Missile Research Division (GMRD). During the first 3 years of operation, GMRD effort was devoted almost exclusively to systems engineering and technical direction of the Atlas, Titan, and Thor ballistic missile programs. During the latter part of 1957, the company drew upon the staffs of the other divisions for transfer to GMRD of technical people, laboratories, and computing facilities to augment and provide specialized strength to the resources of the GMRD. The other divisions of R–W have now as a prime object the development of electronic items and systems for production.

Now the Space Technology Laboratories (STL), formerly GMRD, operating units include three principal elements: An electronics laboratory; an aeronautics laboratory; and a system engineering division. The general STL staff includes a computation and data reduction center and the STL Physical Research Laboratory, which is engaged in fundamental long-range research. The Electronics, Aeronautics, and Physical Research Laboratories provide technical experts to carry on all experimental and analytical work required in the research and development tasks taken on by the Space Technology Laboratories or in support of the Systems Engineering Division. The Systems Engineering Division in turn is the organization which provides the systems management and project control, including associate and subcontractors, for those weapons systems which come under the executive management of BMD and for which BMD contracts with STL for such services. On the cost-plus-fee contract to Ramo-Wooldridge for technical direction, $69,910,000 has been paid through fiscal year 1958.

Financial backing for Ramo-Wooldridge

The Thompson Products Co. during the past 4½ years has made available to Ramo-Wooldridge about $12.9 million in equity capital and loans. As of April 1, 1958, Thompson Products owned 49 percent of the R–W stock; had invested $4.35 million in preferred stock; had furnished $8.5 million in long-term loans, and agreed to increase long-term loans as required, up to a maximum of $16 million.

Fees paid to Ramo-Wooldridge

We noted that over the 3-year period, 1955 through 1957, the fee paid to Ramo-Wooldridge Corp. was more than double the amount of fee paid to other cost-plus-fee contractors visited by the staff in connection with our study of the missile program. The record shows that Ramo-Wooldridge received an average annual fee of 11.9 percent while three other contractors received fees of 5.7 percent, 4.6 percent, and 4.95 percent over the same period.

Salaries of key personnel

The average salary of key personnel was $30,732.

Employment policy for former Government employees

Ramo-Wooldridge employs 700 professional scientists and engineers of whom 64, or 9 percent, are former Government employees. This is in spite of a recruiting policy which we were told was designed to prevent depletion of technical personnel from other segments of the national defense effort.

Salaries of the former Government employees range from $7,288 to $21,000 per year.

$7,000 to $9,000	22
$10,000 to $14,000	33
$15,000 to $21,000	9
Total	64

According to calculations made by the subcommittee staff, 4 of the 64 former Government employees started to work for Ramo-Wooldridge at salaries ranging from $41 to $710 per year less than Government salaries. This may be due to the fact that the subcommittee staff used the "average of the grade" in establishing Government salaries in all cases because Ramo-Wooldridge furnished only the GS grade of former Government employees. However, assuming that these four former Government employees were in the first step of their GS grades, it is unlikely that any Government employee went to Ramo-Wolldridge at less pay.

Increases from $1,500 to $3,500 per year are the most common. There follows a list of former Government employees who accepted responsible positions with R–W at sizable increases in pay in spite of the R–W hands-off recruiting policy.

Government salary	R–W starting salary	Increase over Government	R–W, Apr. 28, 1958, salary	Apr. 28, 1958, increase over Government salary
$12,150	$19,006	$6,856	$19,006	$6,856
12,150	21,000	8,850	21,000	8,850
10,800	18,002	7,202	20,000	9,200
10,965	16,500	5,535	16,500	5,535
10,965	16,016	5,051	18,000	7,035

We do not have dates the 64 employees entered on duty at STL; therefore, some of the increases over Government salaries may reflect only increases between the last Government salary and the starting salary at STL.

The salaries paid by STL should be compared with Applied Physics Laboratory, Bendix and North American Aviation and these should be compared with the lower salaries paid by Government, such as Naval Ordnance Test Station and Holloman Air Force Base. (See Digest of Report, p. 4.)

Observations

In summary, Space Technology Laboratory (STL) is, as of August 1, 1958, an autonomous operating division of the Ramo-Wooldridge Corp. and is the outgrowth of the former Guided Missile Research Division. STL is responsible to the Air Force for systems engineering and technical direction for the Air Force long-range-ballistic-missile programs. In addition, STL performs experimental work in system analysis to help insure the correctness of systems engineering decisions and to advance the missile systems and space technology generally. The Technical staff of STL is the largest single professional group in the Nation devoted exclusively to research, development, and systems engineering in the field of ballistic missiles, space projects and related technology. To perform these functions the Air Force is paying higher fees and Ramo-Wooldridge is paying higher salaries than those

received by other organizations visited by the staff. The comments on overlap made in the BMD section of the report include Ramo-Wooldridge.

The unique position of the Ramo-Wooldridge Corp. in the Air Force ballistic missile complex should, if it has not already, become an indispensable cog in the Air Force management of their ballistic missile program.

Section VIII.—Description of the Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Md.

MISSION

The Applied Physics Laboratory, Johns Hopkins University (APL/JHU), under prime contract to the Navy Bureau of Ordnance, acts as the principal technical adviser for the Bureau of Ordnance in supplying technical direction to the various missile contractors under prime contract to the Bureau of Ordnance. In addition, APL/JHU is the center of a group of universities and contractors engaged in initial development and early design work for guided missile systems to meet Navy requirements. This group is known as section T organization. These activities are all under contract to the Bureau of Ordnance, but APL acts as the executive technical agency and exercises technical direction of the scope and direction of the research. APL and associate contractors carry the design as far as the so-called breadboard.[1] At this point the design is turned over to a manufacturer under a prime contract to the Bureau of Ordnance. The manufacturer takes the initial design (breadboard) and engineers it for production. This includes both product engineering, i.e., translation from breadboard to an actual missile design, and production engineering which considers the aspects of producibility, reliability, cost, etc. For example, in the "Talos" missile program the APL design (breadboard) was turned over to Bendix Aviation Corp., who engineers it for production under a prime contract to the Bureau of Ordnance. The relationship between these two activities, both of which are under direct contract to the Bureau of Ordnance, is that APL serves as the Bureau of Ordnance's principal technical adviser on the program as a whole. Bendix is not under a subcontract, as such, and any program direction given to Bendix is given by the Bureau of Ordnance, after considering the advice of APL.

HISTORY

The history of the Applied Physics Laboratory can be traced back to the formation of the National Defense Research Committee (NDRC) in June 1940 under the chairmanship of Dr. Vannevar Bush. This Committee, a group of the Nation's top scientists, was formed to focus the efforts of the country on the development of new and more powerful weapons to support the Army and Navy. Among the problems considered by this group was the defense of the fleet against attack by aircraft. To meet this problem it was decided to

[1] A breadboard design is defined as an electromechanical or hydraulic design, or a combination of both, which is functionally correct and represents the ultimate functional design but which has not been product engineered. For example, a breadboard electrical circuit of an electrical guidance control would function electrically if "plugged in" but would not conform to the rounded shape of the missile because it is not product engineered by APL.

attempt the development of radio proximity fuses for antiaircraft shells. A unit, designated section T, was established in August 1940 under the chairmanship of Dr. Merle Tuve to undertake this task. Dr. Tuve was then a member of the staff of the department of terrestrial magnetism of the Carnegie Institution of Washington.

SECTION T CONTRACTORS

In January 1942, section T was transferred to the Office of Scientific Research and Development (OSRD), which had been established in June 1941. It was at this point that the Johns Hopkins University first joined the section. In March 1942 the Johns Hopkins University accepted an OSRD contract to administer the work of section T on fuses for rotating missiles. The university established the Applied Physics Laboratory in Silver Spring, Md., as the central laboratory for the program, under the direction of Dr. Merle Tuve and Dr. L. R. Hafstad, with D. Luke Hopkins of the university's board of trustees as authorized representative of the university.

The university has continued the operation of the laboratory and its technical direction of the section T program in a pattern of operation similar to that developed under OSRD. Dr. Hafstad was appointed director of research in February 1946. Dr. R. E. Gibson has been director of the laboratory since July 1947. In March 1948 the laboratory was established as a regular division of the university.

BUMBLEBEE PROGRAM

As an outgrowth of earlier preliminary studies by APL/JHU, the Navy assigned to them in January 1945 the extensive task of guided missile research and development which became known as the Bumblebee program. The specific objective of the program was to develop guided missile technology in order to supply the Navy with a supersonic missile which would meet tactical requirements. To meet the Bureau of Ordnance requirements, the laboratory established research and development programs in the fields of propulsion, aerodynamics, radar, guidance and control systems, launching warheads, telemetering and ground and flight testing.

In 1945 ramjets were known only in theory and the subject of aerodynamic stability and control at supersonic speeds was entirely unexplored. Moreover, there were not facilities adequate for such study and analysis. Early in the year of 1945, as laboratories for testing ramjets up to 6 inches in diameter were established, the Bendix Aviation Corp. was approached by APL/JHU with a request for the development of the fuel metering system for a ramjet propelled missile. The successful development of the fuel metering system was borne out by the 1945–49 series of flight tests of the Cobra missile.

The success of the ramjet led to the development of additional experimental propulsion missiles. XPM airframe was supplied by Convair while Bendix assumed complete responsibility to furnish fuel and hydraulic systems, to provide missile test equipment, and to assemble all packages in the missile, as well as to initiate coordinated tests of the completed missile.

During 1951 and 1952, with Bendix Products Missile Division as prime contractor, six ramjet test vehicles were flight tested at White Sands Proving Ground, N. Mex.

Testing of the Talos tactical missiles began in October 1952. Several missiles were flown to demonstrate performance of the propulsion, control, and beamriding systems. Subsequent missiles were flown to evaluate the complete homing—steering intelligence systems.

A number of experimental surface-to-air missiles have been built and the design successfully demonstrated.

Although initially organized for the development of the ramjet-propelled Talos missile, APL has undertaken the development of two shorter range, solid-rocket-propelled supersonic antiaircraft missiles designated "Terrier" and "Tartar." In addition, Project Bumblebee has been extended to include a long-range, supersonic, ramjet-propelled bombardment missile (Triton) and a subsonic, line-of-sight, antipersonnel, antiemplacement missile (Cannonball), both of which are capable of being launched from a submarine but both missiles have been shelved by the Navy.

In summary, the Bumblebee program has developed guided missiles. The Cobra, the original flying stovepipe, was used for initial ramjet experiments. The Aerobee is a high altitude test vehicle. The Terrier became the first guided missile to be approved for use in the fleet. It is now in use in the fleet on the cruisers U.S.S. *Boston* (1955), the U.S.S. *Canberra* (1956), and the destroyer U.S.S. *Gyatt* (1956). The Talos is currently undergoing evaluation aboard the U.S.S. *Galveston*. Since 1955 development has been continuing on Tartar, a short-range, homing missile designed to replace a 5-inch gun turret. While designed for use on ships as small as destroyers, and as secondary batteries on larger ships, Tartar will have the same aerodynamic configuration and guidance and control components as the homing version of the Advance Terrier.

APL RESEARCH AND DEVELOPMENT PROGRAM

In addition to the guided missile development program, APL also pursues a research and development program designed to advance the various fields of science and engineering that underlie missile technology and to provide an understanding of the phenomena encountered. For the Bureau of Ordnance, the Research Center of APL conducts fundamental research studies in fields related to APL's main task in an environment appropriate to the university. These studies are not limited by time scales or immediate objectives, and the results are published in scientific journals. For example, one such study was a project for the exploration of the physics of the upper atmosphere by means of instruments carried in V and Aerobee rockets. The rockets, launched at White Sands Proving Grounds, N. Mex., and from aboard ship in the Arctic regions and at the Equator, carried such equipment as Geiger counters for cosmic ray research, cameras, and specially built solar spectographs. According to APL, this work, in addition to increasing basic knowledge of upper atmosphere physics, is of practical importance in obtaining data necessary for high altitude flight and the handling and launching of rockets.

PAYMENTS IN BUREAU OF ORDNANCE CONTRACT 7386 WITH APL/JHU

Initial contract July 1, 1945	$2, 500, 000. 00
Cumulative total July 1, 1945 to 1956	76, 147, 447. 07
1956	14, 856, 553. 00
Cumulative total	91, 004, 000. 07
1957 [1]	14, 049, 374. 00
Cumulative total	105, 053, 374. 07

[1] September 1957, the date of the last amend ment to the contract, at the time of our visit to APL extended the contract another year.

APL/JHU was paid a fixed fee of 4½ percent on the last extension of the contract. Over the life of the contract, the fees have averaged 4¾ percent.

ORGANIZATION AND QUALIFICATIONS OF STAFF MEMBERS AT APPLIED PHYSICS LABORATORY

The total staff of APL was 1,329 as of December 31, 1957. Organizationally the staff is distributed as follows:

Director and staff	139
Bumblebee operations	706
Administrative	438
Research	46
Total	1, 329

Distribution of staff according to technical skills is as follows:

Professional technical	527
Supporting technical	234
Professional and supporting administrative	568
Total	1, 329

The Director of the Laboratory furnished information showing that the average age of the professional technician is 38 years with an average length of service of 5.7 years. Distribution by academic degree is as follows:

	Percent
PHD	16
MS	23
BS	49
None	12

The average age of the supporting technical staff members is 37 years with an average length of service of 5.5 years.

The combined service of the professional, technical, and supporting technical staff represents about 4,325 man-years of experience at the Laboratory on ordnance research and development, of which approximately 4,000 man-years have been devoted to guided missile research and development.

APPLIED PHYSICS LABORATORY QUARTERLY REPORTS

The APL publishes a two-volume classified quarterly report of review of Bumblebee activities. The purpose of the quarterly review is to present a comprehensive account of the guided missile development activities of APL and its associated section T contractors in the

Bumblebee project. The first volume contains material relating directly to the missile programs and bears the overall classification of secret. Volume I is intended primarily for Government activities. The second volume which contains research and development material and a publications listing bears the overall classification of confidential.

There follows a list of Government agencies and individuals who have BuOrd approval to receive these publications. Some bureaus within an agency receive more than one copy of each publication.

	Vol. I	Vol. II
Department of Defense	8	8
Department of Air Force	19	24
Department of Army	25	41
Department of Navy	26	42
Contractors	6	10
Special list approved by BuOrd letter July 1, 1957	11	9
Government agencies, such as Atomic Energy Commission and the National Advisory Committee for Aeronautics	4	7
Total	99	141

TURNOVER OF PERSONNEL

None of the key professional personnel is a former Federal Government employee unless he joined APL staff prior to January 1, 1955.

Since January 1, 1955, APL hired 28 professional employees whose last prior employment was with the United States Government. Six of the twenty-eight employees have resigned. Three of the six returned to Government and two went to industry. APL records do not show where the sixth person is presently employed.

SALARIES OF EXECUTIVE AND KEY PERSONNEL

The average salary of key personnel was $15,540.

OBSERVATIONS

APL is supplying technical direction to the various missile contractors under prime contract to the Bureau of Ordnance. They have produced guided missiles for the Navy with less costs and smaller fees than other contractors performing similar services. The salary structure for scientists and engineers is only slightly higher than is paid to Government scientists and engineers.

Officers of the company have expressed concern over the expenditures and salaries permitted other Government contractors performing like services, and specifically cited Ramo-Wooldridge. They feel the disparity works a hardship on their organization and its trained personnel.

SECTION IX.—BENDIX AVIATION CORP.

ORGANIZATION

Bendix Products Division at South Bend, Ind., is 1 of 25 principal divisions of the Bendix Aviation Corp. in the United States and 12 subsidiaries and affiliates in the United States and foreign countries.

Bendix Products Division—Missiles, at Mishawaka, Ind., is a part of the South Bend operation. The missiles division, under a prime

contract with the Bureau of Ordnance, receives the initial (breadboard) design from APL and engineers it for production. This includes both product engineering, i.e., translation from breadboard to an actual missile design, and production engineering which considers the aspects of producibility, reliability, costs, etc.

At the present time, the Bendix Aviation Corp. is producing two versions of the Talos missile, the W-type warhead and the homing missile.

The missile plant employs approximately 1,500 persons of which one-third are engaged in the engineering function while the remaining two-thirds are production employees.

BENDIX CONTRACTS WITH BUREAU OF ORDNANCE

Between July 1, 1945, and December 2, 1957, the Bureau of Ordnance awarded contracts to the Bendix Products Division totaling $221,319,448 for research, engineering and production of the missiles.

COST PER MISSILE

On the basis of total expenditures through part of fiscal year 1958 of more than $190 million, the average cost per missile is in excess of $759,000 including amortization of engineering. Since the missile is still in the experimental stage, it is expected that the cost per missile will be reduced with greater production. This initial cost is for the part of the Talos missile body as engineered and assembled by Bendix. It does not include the cost of the booster and the warhead which are manufactured elsewhere. Neither does it include the cost of research and development and breadboard design furnished the Bendix plant by APL, nor incidental research and development assistance supplied by strictly Government laboratories, such as Naval Ordnance Laboratory White Oak, Md., nor the Naval Research Laboratory, Anacostia, D.C.

BUREAU OF ORDNANCE CONTRACTS WITH BENDIX BY CALENDAR YEARS 1945 THROUGH 1957

1945–49	$14, 373, 819	1955	$18, 207, 056
1950	1, 819, 074	1956	46, 904, 888
1951	35, 083, 144	1957	30, 242, 178
1952	46, 212, 009		
1953	2, 035, 955	Total	221, 319, 448
1954	26, 441, 325		

The fee received by Bendix on contracts with Bureau of Ordnance has been approximately 5 percent.

BENDIX PRODUCTS DIVISION SUBCONTRACTORS

In the course of the manufacturing process Bendix now uses approximately 125 suppliers of hardware and parts for Talos. Forty-one suppliers furnish 95 percent of the dollar volume of procurement. During the staff visit to Bendix, a conference was held with the Air Force area audit officer who has the responsibility for auditing the Bendix contract for the Bureau of Ordnance. He said they had experienced no unusual difficulties in the audit; that Bendix cooperated with the auditors and that Bendix officials were reasonable in their

discussion of audit problems with the auditors. The area auditor stated further that Bendix Products Division did not pay a fee for work performed by another Bendix Division or affiliate. Fees are paid to other suppliers (subcontractors) but only when it would be customary practice in the industry. The Air Force auditors had found no fault with the manner in which fees were handled at Bendix. The staff members asked if Bendix Products Division retained or charged BuOrd any part of a fee when 100 percent of a job order was farmed out to a subcontractor. The area auditor replied that in such cases Bendix charged BuOrd a small amount of fee on the theory that a certain amount of paperwork is always involved and employees must be retained. The resident area auditors said they had not taken exception to this practice.

BUREAU OF ORDNANCE LIAISON WITH BENDIX PRODUCTS DIVISION

Information furnished by Bendix Products Division indicates that BuOrd personnel make frequent visits to the Bendix plant.

A comparison of the names of the BuOrd visitors furnished by Bendix with records of the BuOrd show that the visitors were from organizations in the Bureau dealing with the missile program. The bulk of business with the Navy is now conducted through the Office of Inspector for Ordnance located at the Bendix plant.

APPLIED PHYSICS LABORATORY LIAISON WITH BENDIX PRODUCTS DIVISION

Aside from telephone contact with the Bendix plant information furnished from Bendix records indicates that APL engineering and administrative personnel make frequent official trips to Bendix.

Three years ago APL had technical consultants at the Bendix plant. Now technical details have been worked out and consultation between Bendix and APL is handled during business trips between representatives of the two companies.

SALARIES OF KEY PERSONNEL

The average salary of key personnel was $13,746.

GOVERNMENT EMPLOYEES HIRED BY BENDIX AFTER JAN. 1, 1955

	Number employed after Jan. 1, 1955	Number on rolls May 1958	Number resigned from Bendix [1]
Civilian employees of military installations	4	1	3
Military personnel	23	19	4
Total	27	20	7

[1] Reasons for leaving Bendix: 1 returned to Government; 6 to industry (3 for more money).

Of the 27 former Government employees hired by Bendix since January 1, 1955, 3 came to Bendix for less money.

With the exception of three or four enlisted men who were apparently released by the Army and Navy and joined Bendix engineering staff at increases ranging from $1,020 to $5,700 a year, the increases

received by former Government employees were nominal—ranging from $60 to approximately $900 annually.

Records submitted by Bendix disclose that no member of the staff occupying a key position was on the list of Government employees who were hired by Bendix after January 1, 1955.

BENDIX EMPLOYEES HIRED BY RAMO-WOOLDRIDGE CORP.

In 1955, a staff assistant in Bendix Aviation Missile Division at $12,000, resigned to go to the Ramo-Wooldridge Corp. As of April 1958, this man was earning $19,600 a year as a senior research engineer at Ramo-Wooldridge Corp.

Other engineers from Bendix may have been employed by Ramo-Wooldridge but they could not be identified in the records and personnel at Bendix stated that they would not know how many of their former engineers had been employed by Ramo-Wooldridge Corp. Although officials of Bendix referred to Ramo-Wooldridge as a company who had employed engineers from other companies because Ramo-Wooldridge was able to pay bigger salaries these officials were reluctant to be more specific and the staff had to rely on the information shown in the records made available to us. No other engineers could be identified as employees of Ramo-Wooldridge but formerly with Bendix.

TURNOVER OF ENGINEERS

Reasons	1955	1956	1957	1958	Total
To accept another position	25	30	19	3	77
Military leave	4	6	14	4	28
Final release-incompetent, etc.	3	1	3	4	11
Family, other personal reasons	5	4	7	2	18
Transfer within Bendix Corp.	6	3	0	0	9
Death	0	0	1	1	2
Total	43	44	44	[1] 14	145

[1] Total through May 1958.

OBSERVATIONS

Bendix Products Division-Missiles, Mishawaka, Ind., is a part of the Bendix Products Corp., South Bend, Ind., Division. They have performed experimental work for the Navy Bureau of Ordnance as a part of the section T group of contractors under the technical direction of the Applied Physics Laboratory of Johns Hopkins University. They now have a contract with BuOrd to produce the Talos missile under the technical direction of APL/Johns Hopkins University. Navy BuOrd has paid Bendix in excess of $221 million from 1945 to 1958. The fee received by Bendix on contracts with BuOrd has been approximately 5 percent.

SECTION X.—DESCRIPTION OF NORTH AMERICAN AVIATION MISSILE DEVELOPMENT DIVISION, INC., DOWNEY, CALIF.

DEVELOPMENT OF MISSILE DIVISION, DOWNEY, CALIF.

The North American Aviation Corp. has six divisions, the Los Angeles Division of Los Angeles, Calif.; Columbus Division, Columbus,

Ohio, the Rocketdyne Division, Canoga Park, Calif.; the Missile Development Division, Downey, Calif., the Autonetics Division, Downey, Calif., and the Atomics International Division of Canoga Park, Calif. All the company's airplane manufacturing and development programs are conducted by the Los Angeles and Columbus divisions. The Los Angeles division is engaged in work for the Air Force, while the company's aircraft programs for the Navy are conducted at the Columbus division.

The company's Rocketdyne Division of Canoga Park, Calif., performs research in development of rocket engine fuels and engine performance reliability. This division in the past has operated as a part of the company's missile organization.

Formerly the electromechanical engineering and manufacturing departments of the company's missile organization, the Autonetics Division is engaged principally in the development engineering and manufacturing of automatic navigation and control equipment for aircraft and missiles.

The principal activities of the Atomics International Division of Canoga Park, Calif., are the design, development, manufacture and operation of nuclear reactors for generation of power for research.

NAVAHO MISSILE

The company's missile work is performed through its missile development division located in Downey, Calif. The present organization is an outgrowth of the company's development work begun after World War II. This initial work eventually led to an Air Force contract for the development of the "Navaho," an intercontinental guided missile.

The Missile Development Division began in 1946 as a missile engineering study group in the contractor's Los Angeles plant where it was known as the Aerophysics Department. In 1948 the Aerophysics Department was moved to the Downey plant. The effort conducted by this department was primarily devoted to the development of an intercontinental, airbreathing, guided missile system for the Air Force known as the Navaho weapon system. This original group eventually developed into the Missile Development Division, a research and development, manufacturing organization to undertake a missile weapon system from design and development through flight test and production. Two other divisions, one related to guidance and the other to rocket engines arose from this original aerophysics group, along with the Missile Development Division and are now operating organizations known as the Autonetics Division, Downey, Calif., and the Rocketdyne Division, Canoga Park, Calif.

The major portion of the Navaho contract was terminated by the Air Force in August 1957. The Missile Development Division employed about 7,000 people, of whom 1,800 were engineers in the Navaho program. About 23 million engineering-hours of missile experience were accumulated in connection with the Navaho program. The present division employment is approximately 2,800, including a small contingent at the Air Force Missile Test Center, Patrick Air Force Base, Fla.

Since the termination of the major portion of the Navaho program the Missile Development Division has been awarded a design and

development contract by the Air Force for Weapon System 131B (Hound Dog project), an air-breathing air-to-surface guided missile for the B–52 aircraft. The division has also made proposals on other weapon efforts, including a weapon system for the Navy, and a research program involving seven remaining Navaho missiles.

SUMMARY OF PERSONNEL BY MAJOR FUNCTIONAL OCCUPATION AS OF APRIL 1, 1958

As previously shown the Missile Development Division employed 7,000 people during the life of the Navaho contract but since the termination of this contract they have reduced their force until it is now about 2,600, excluding the small contingent at Patrick Air Force Base. A breakdown of this employment by principal categories shows:

Administration	78
Professional	850
Supporting-technical	319
All others [1]	1,373
Total personnel	2,620

[1] All others include facilities, M.D. Lab., financial, and other supporting departments.

FUNDING AND PROJECTS OF THE M.D.D., NORTH AMERICAN AVIATION, INC.

From the inception of the Missile Development Division to August 1957, the time of termination, its efforts were directed almost completely to the development, production and testing of the Air Force weapon system, Navaho. Since the termination of Navaho the division has been engaged in the production of the Air Force weapon project known as Hound Dog. The total sales for all contracts through March 31, 1958, have been $479,734,006 including fees of $26,300,511. The percentages of fees have ranged from 4.9 percent in fiscal year 1950 to 6.4 percent in fiscal year 1957.

The plant facilities of the Missile Development Division cover an area of approximately 1,397,007 feet, of which 1,288,000 feet are Government-furnished areas, 6,367 feet are North American erected buildings on Government area, and 83,000 feet are NAA leased buildings on leased land and 20,000 feet are other leased property.

SALARIES OF KEY PERSONNEL

The average salary of key personnel was $21,125.

OBSERVATIONS

The Missile Development Division of North American Aviation Corp., Downey, Calif., is one of three divisions of NAA that has grown out of a small nucleous known as the Aerophysics Department since 1948. Their principal project has been the Navaho missile which never fully developed to production capacity although nearly $500 million was paid to North American for the project. At the time of our visit the plant was on a "between contracts" status with employment down 75 percent as compared to 1956. The division was in the process of negotiating new contracts with the Navy and Air Force.

APPENDIX

DECEMBER 4, 1957.

Hon. NEIL H. MCELROY,
Secretary of Defense,
Washington, D.C.

MY DEAR MR. SECRETARY: Under authority of House Resolution 139, 85th Congress, the Subcommittee on Manpower Utilization is making a study of the utilization of scientists and engineers. In our hearings we received information indicating that some of the practices in Government contracting lead to duplication of effort, overlapping of functions, and other wasteful practices in the utilization of scientists and engineers. One of the examples called to our attention was the time spent by engineers and scientists in performing routine administrative duties.

As a part of the study by this subcommittee we wish to make an analysis of a contract between the Department of the Navy and Johns Hopkins University. According to our information a corporation formed by Johns Hopkins University is the prime contractor and Bendix Corp. is the subcontractor for a missile contract. Our interest is a review of the work of each production unit, in this case, the Bendix Corp., then Johns Hopkins University, Department of Navy, Department of Defense, Research and Engineering, Assistant Secretary of Defense for Missiles, and now the President's assistant for science and technology, Dr. James R. Killian, Jr. Also we may be interested in contacting other agencies of the Government engaged in the program, such as the Office of Defense Mobilization.

We are designating Mr. W. Carter Ayres and Mr. Joseph M. Mannix of our staff to make this study. We would appreciate your making such arrangements as are necessary for their access to the appropriate records and personnel of the Government, the contractor, and subcontractors, as well as for any other assistance required in their study.

Your cooperation in this matter will assist the subcommittee in obtaining a more thorough understanding of your programs for the utilization of scientists and engineers.

Sincerely yours,

JAMES C. DAVIS, *Chairman.*

CC: Hon. Thomas S. Gates, Jr., Secretary of the Navy.
Dr. James R. Killian, Jr., assistant to the President for science and technology.
Mr. Gus Lee, Director of Manpower Utilization, Office of the Secretary of Defense.

MARCH 12, 1958.

Hon. NEIL H. MCELROY,
Secretary of Defense,
Washington, D.C.

MY DEAR MR. SECRETARY: In a letter dated December 4, 1957, to you I indicated the Subcommittee on Manpower Utilization, under House Resolution 139, 85th Congress, was making a study of the utilization of engineers and scientists and requested information concerning certain Navy missile programs. This included the extent to which the Defense Department has entered into contracts outside the Federal Government for administrative and management services and the effect of the contracting practices on the availability and utilization of Defense personnel. At that time I also indicated the subcommittee's interest in the missile program might be extended beyond the Department of the Navy.

In order that our subcommittee might have a more complete and comprehensive picture of manpower requirements for the Defense Department's missile programs it is requested that arrangements be completed for our staff to contact designated representatives in the Office of the Assistant Secretary for Defense (Research and Engineering), the Department of Air Force, as well as the Department of the Navy, as soon as possible for such personnel and cost data and other assistance deemed necessary to complete this study.

We will be particularly interested in the number of personnel in the various organizational units in the above-named agencies who are currently working on the planning, research, testing and production of missiles. This would include one or more Defense field activity and one or more Defense contractor.

Mr. Bun Benton Bray, Jr., of our staff, joins the previously designated staff members, Mr. Ayres and Mr. Mannix, in making this study.

Your continued cooperation will be most appreciated.

Sincerely yours,

JAMES C. DAVIS, *Chairman.*

CC: Hon. Thomas S. Gates, Jr., Secretary of the Navy.
Hon. J. H. Douglas, Secretary of the Air Force.
Hon. Paul D. Foote, Assistant Secretary of Defense (R. & E.).
Hon. W. F. Francis, Assistant Secretary of Defense (MP. & R.).

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington, D.C., February 25, 1959.

Circular No. A–49.

To the heads of executive departments and establishments.

Subject: Use of management and operating contracts.

1. *Purpose.*—This circular establishes general criteria to assist Federal agencies in developing policies concerning the use of management and operating contracts. The circular has been developed in consultation with the agencies concerned and is based upon the most successful agency experience. Nothing in this circular shall be construed to modify provisions of applicable laws, Executive orders, agency regulations, or existing contracts, including renewals thereof.

2. *Definition of management and operating contracts.*—As used in this circular, the term "management and operating contract" applies to cost-reimbursement type contracts under which the Government contracts with nonprofit institutions, private businesses, or universities: (*a*) To administer, on behalf of the Government, research or development establishments wholly devoted to Government work or Government research or development programs; (*b*) to administer and operate Government-owned or leased industrial facilities; or (*c*) to provide such personal or professional services as are authorized by law.

3. *Establishment of criteria for use of management and operating contracts.*—Each agency that uses or expects to use management and operating contracts, as defined in paragraph 2, should develop criteria defining the circumstances in which this type of contract may be employed as an alternative to procurement of goods and services directly from non-Government suppliers or to Government operation. These criteria should generally take into account the factors listed below, together with such other considerations as are peculiarly appropriate to the agency.

(*a*) Management and operating contracts have been found particularly useful for the performance of functions requiring specialized knowledge and experience in large scale industrial management or in conduct of research.

(*b*) Management and operating contracts have been employed successfully when unusual speed has been required in the organization of a new program or service.

(*c*) Use of a management and operating contract is not generally considered suitable unless:

(1) Contractor operations are judged to be more economical than direct operation by the agency, or where probable increased cost of contractor operations is likely to be outweighed by a significant increase in effectiveness of operations;

(2) The agency has no essential need for the inservice capability which would be acquired if agency personnel performed the function; or the agency cannot perform the function at the standard of excellence required or within the time limit or under other conditions required;

(3) The products or services required are not readily obtainable from another Federal agency;

(4) Qualified contractors, desirous of performing the function, are known to be available and willing to assume full management responsibility; and

(5) As a minimum, the agency has made a finding that the product or service cannot be procured from private enterprise through ordinary business channels.

(*d*) Management and operating contracts are not regarded as suitable for the performance of the following functions:

(1) Functions involving the direction, supervision, and control of Government personnel, except for supervision incidental to training;

(2) Functions involving the exercise of police and regulatory powers in the name of the Government, exclusive of guard and plant protection services;

(3) Functions of determining basic Government policies;

(4) The day-to-day staff and management functions of the agency, or any element thereof, such as internal personnel administration and budget preparation (other than specialized studies of an intermittent nature relating to the analysis of organization, personnel administration, and management systems).

4. *Selection and supervision of contractors.*—Suggestions concerning procedures to be followed in the selection and supervision of management and operating contractors are set forth in attachment A, "Suggestions Relating to Selection and Supervision of Contractors."

MAURICE H. STANS, *Director.*

Attachment.

[ATTACHMENT A] CIRCULAR NO. A–49—SUGGESTIONS RELATING TO SELECTION AND SUPERVISION OF CONTRACTORS

1. *Purpose.*—This attachment sets forth a number of suggestions to assist Federal agencies in developing procedures for the selection and supervision of management and operating contractors. These suggestions generally are based on successful current agency experience.

2. *Selection of the contractor.*—Agencies that make use of management and operating contracts should take the necessary steps to assure that a fully qualified contractor is selected. The following steps should be included in the agency's selection process:

(*a*) Selection of organizations to submit proposals:

(1) The agency should in all cases canvass the field of potential contractors to assure the selection of the best available contractor, and to allow for favorable negotiating conditions.

(2) The agency should request proposals only from reputable and established organizations with experience in the field or in related fields. Ability and experience in the management of the type of facility or program should be considered as well as other qualifications.

(3) The agency should require the organizations submitting proposals to indicate the names and qualifications and the total number of key staff that would be made available.

(4) The agency should consider other feasible alternatives and contractors before requesting an institution of higher learning directly to administer a large-scale applied research and development facility under an operating and management contract, particularly if the work is concerned with development and testing.

(*b*) Selection of the contractor: In the final selection, the agency should give emphasis to the following factors:

(1) Reputation and standing of the organization in its field;

(2) Past record in work for the contracting agency and other Federal agencies;

(3) Adequacy of the contractor's existing organization, and extent of contribution expected from existing facilities and organization;

(4) Quality and quantity of key personnel to be assigned;

(5) Financial resources available to the contractor;

(6) Avoidance of contracts which might tend to promote a private monopoly.

(*c*) Absence of qualified contractors: If no qualified organizations are able or desire to perform the function required under the contract, the decision to contract should be reconsidered. The alternative of an outside independent organization being created to perform the contract should not be used except where no other arrangement would be in the best interests of the Government.

3. *Supervision and evaluation of contractors.*—Agencies should take the necessary steps to assure that contractors operate with maximum efficiency. Proper discharge of a contractor's responsibilities for management requires that, to the fullest extent compatible with law, he be encouraged to exercise maximum initiative and ingenuity. Proper discharge of the responsibilities of the Government requires that the contracting agency have full access to all pertinent information concerning the contract and the contractor's performance and possess the power to exercise such control and supervision as may be found necessary.

The following guidelines describe suggested methods of supervising the contractor and of evaluating his performance:

(*a*) Management appraisal: Periodic appraisals of the overall performance of contractors should be made by the administering agency. Basic to the ability to evaluate or appraise is the existence of performance standards and the comprehensive collection and analysis of information on all aspects of performance, managerial and programatic.

Agencies should make use of such yardsticks as comparison of performance with previous years and with other contractors and industries performing the same or similar functions. To reduce costs among contractors performing similar functions, competition should be encouraged whenever feasible.

The contractor's systems, methods, and controls should be appraised in the early stages of contract negotiation and reviewed periodically thereafter. Their relative effectiveness should determine the degree of control over the contractor.

(*b*) Audit: Provision should be made for a Government postaudit designed to test the adequacy of the contractor's accounting records and internal financial controls; to verify expenditures for reimburse-

ment and compliance with the terms of the contract; and to establish the integrity of the contractor's financial representations.

(*c*) Preapproval of vouchers: If there is adequate postaudit, and the contractor's systems and procedures are satisfactory, detailed prior approval of purchase orders, personnel actions, travel vouchers, and the like, is both undesirable and unnecessary. As the Government develops confidence in the contractor, the preferred practice is progressively to increase the dollar limits, subject to provisions of applicable laws, under which the contractor can spend without prior approval.

(*d*) Budgets: Except for contracts for personal or professional services, the contractor should be required, at least annually, to develop and present for agency review and approval the estimated costs of accomplishing established program goals.

(*e*) Personnel: Because of the critical importance of the quality of top management, the agency should retain the right under the contract to review and approve proposed appointments to principal executive positions under the contract. The agency should also retain the right to require the contractor to withdraw unsatisfactory personnel from the contract activities. Below the top level, and with the exception of security clearances, the agency should limit its approval powers to the grade and salary structure and personnel system established for the activity under contract.

(*f*) Assignment of Government personnel to the contract site: Agencies should emphasize the quality of staff assigned to the contract activity, rather than quantity. The number of Government employees should be limited. Top staff should have the rank and stature to enable them to work effectively with top contractor personnel.

(*g*) Use of contractor's supervisory staff: Agencies should encourage contractors to evaluate their own performance systematically in order to reduce the need for Government supervision, especially by:

(1) Establishment of management appraisal systems, including internal audits, to keep contractor and agency management currently informed of the effectiveness of operations, which is useful in industrial operations; and

(2) Appointment of visiting committees of experts to appraise activities on a periodic basis, which is useful in research and development laboratories.

4. *General contracting guidelines.*—

(*a*) Costs: Operating and management contracts should include provisions specifying the manner in which the contractor will be reimbursed for the cost of carrying out the work under the contract and incorporate by reference established comprehensive cost principles, or include them in the contract when incorporating by reference is impracticable. Where established cost principles are not applicable, provisions should either list the specific costs to be reimbursed or set forth the cost-accounting principles which will govern the determination of amounts to be reimbursed. It is also desirable to list unallowable costs in the contract. It may further be feasible to list only certain specific costs and to set forth the principles for determining other costs. In any case, contract provisions should indicate that costs are to be fair and reasonable and chargeable directly or allocable to the contract in accordance with generally accepted accounting principles and practices. Unusual costs requiring special considera-

tion for inclusion or exclusion should be specifically mentioned if they are not covered adequately by any cost principles which may be mentioned in the contract.

(*b*) Purchases from sources controlled by contractor: Agencies should require advance notice of proposed purchases by a contractor from sources under his control. Agencies should reserve authority to determine whether such purchases would be advantageous to the Government and to prescribe procurement from other sources when deemed necessary to secure full and free competition.

(*c*) Incentives: Agencies should adopt policies which will provide an incentive to efficient and economical performance under these contracts.

DEPARTMENT OF THE AIR FORCE,
HEADQUARTERS, U.S. AIR FORCE,
Washington, D.C.

AFOMO–01

Memorandum for Mr. J. W. Mannix.

The following gentlemen were members of the Von Neumann Committee:

Professors:
- John Von Neumann, chairman.
- Clark B. Millikan.
- Charles C. Lauritsen.
- J. B. Wiesner.

Doctors:
- Louis G. Dunn.
- Hendrik W. Bode.
- Allen E. Puckett.
- George B. Kistiakowsky
- Simon Ramo
- Dean Woolridge.

Mr. Lawrence A. Hyland.

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